

VOL. XXV, PART IV

Published 31 December 1942

The British Mycological Society

(Recognosce notum, ignotum inspice)

TRANSACTIONS

Edited by

J. RAMSBOTTOM, B. BARNES and H. WORMALD

Price to non-members, Seven Shillings and Sixpence net.



CAMBRIDGE UNIVERSITY PRESS

LONDON: BENTLEY HOUSE

CHICAGO: THE UNIVERSITY OF CHICAGO PRESS
(AGENTS FOR THE UNITED STATES)

BOMBAY, CALCUTTA, MADRAS: MACMILLAN

All rights reserved

PRINTED IN GREAT BRITAIN

LIST OF OFFICERS AND COUNCIL FOR 1942

Elected December 1941

President

Miss E. M. BLACKWELL, M.Sc., F.L.S.

Vice-Presidents

W. C. MOORE, M.A.

H. WORMALD, D.Sc., A.R.C.S.

W. BUDDIN, M.A.

General Secretary

J. RAMSBOTTOM, O.B.E., Dr.Sc., M.A., V.-P. L.S.
British Museum (Nat. Hist.), Cromwell Road, London, S.W. 7

Secretary

G. C. AINSWORTH, B.Sc., Ph.D.
Imperial Mycological Institute, Ferry Lane, Kew, Surrey

Treasurer

A. A. PEARSON, F.L.S.
Nutcombe House, Hindhead Road, Hindhead, Surrey

Editors

Dr J. RAMSBOTTOM, Dr B. BARNES and Dr H. WORMALD

COUNCIL

The OFFICERS, with the following in addition:

SIR R. H. BIFFEN, Prof. F. T. BROOKS, Prof. W. BROWN, Prof. A. H. R. BULLER, Sir E. J. BUTLER, A. D. COTTON, Dr G. E. DEACON, S. D. GARRETT, F. G. GOULD, Dr P. H. GREGORY, R. V. HARRIS, S. G. HUGHES, Prof. Dame HELEN GWYNNE-VAUGHAN, Miss G. LISTER, Mrs E. W. MASON, T. PETCH, Dr G. H. PETHYBRIDGE, Prof. M. C. POTTER, N. C. PRESTON, C. REA, Dr A. SMITH, G. SMITH, E. W. SWANTON, Miss E. M. WAKEFIELD.

PLANT PATHOLOGY COMMITTEE

Dr P. H. GREGORY (*Secretary*) Rothamsted Experiment Station, Harpenden, Herts.

Dr. G. R. BISBY

W. BUDDIN

W. R. DAY

Dr W. J. DOWSON

Dr W. P. K. FINDLAY

S. D. GARRETT

Dr T. H. HARRISON

R. W. MARSH

M. H. MOORE

Dr A. SMITH

Dr J. H. WESTERN

THE PRESIDENT and SECRETARIES of the Society *ex officio*.

The subscription price is £1. 10s. per volume (post-free), payable in advance; single members 7s. 6d. net (double members 15s. net). Subscriptions may be sent to any Bookseller, or to the Cambridge University Press, Bentley House, 200 Euston Road, N.W. 1.

The Cambridge University Press has appointed the University of Chicago Press agents for the sale of *The British Mycological Society's Transactions* in the United States of America.

AQUATIC HYPHOMYCETES OF DECAYING
ALDER LEAVES

By C. T. INGOLD

Department of Botany, University College, Leicester

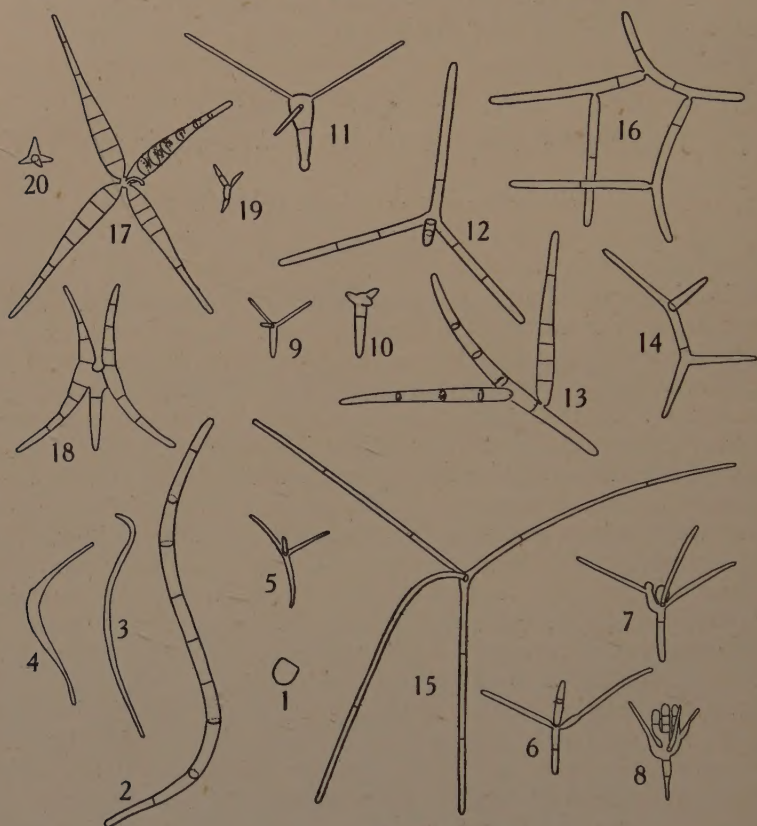
(With Plates XII-XVII and 48 Text-figures)

INTRODUCTION

The fungi described in this paper were first encountered as spores suspended in the water of a small stream which drains Cropston Reservoir near Leicester. When this water was examined in July 1940, it was found to contain a remarkable collection of fungal spores (Text-fig. 1). Some twenty different kinds of spore were recognized, each very constant in form (with the exception of no. 16 in which the degree of branching varied considerably). This suggested that each kind represented a separate species or at least a separate spore stage. Of the twenty kinds, only one (no. 1) was nearly spherical; three had long fusiform or sigmoid spores (nos. 2-4), the remainder (nos. 5-20) had branching spores, and of these most kinds were constructed of four divergent arms. All the different spores were encountered repeatedly in many samples of stream water collected during July-September 1940. All were colourless.

It was not until November 1940 that most of the fungi (sixteen out of twenty), from which these spores were derived, were found growing and sporulating on decaying alder leaves in the bed of the stream several inches below the surface of the water; all were aquatic Hyphomycetes. The conidial stages were found on the leaves taken directly from the stream, particularly during the summer months (May-August 1941). During the winter months (November 1940-March 1941) the conidial stages were developed only very poorly on the leaves taken straight from the stream. However, when the leaves were placed in shallow dishes of water, in the laboratory, rich crops of conidiophores developed during the following two days. The most suitable leaves were those which decay had reduced to leaf skeletons, but which had not reached the slimy stage. The mycelium appears to lie mainly within the petioles and veins from which the conidiophores grow out at right angles into the water. The conidiophores are normally completely submerged, and the spores are liberated below water.

The fungal flora of the leaves during the whole year appears to be dominated largely by these aquatic Hyphomycetes, although occasionally a few Oomycetes (species of *Pythium* and *Phytophthora*) are also



Text-fig. 1. Types of spore found in the stream water. 1, *Margaritispora aquatica* n.gen., n.sp.; 2, *Anguillospora longissima* (Sacc. & Syd.) n.comb.; 3, *Flagellospora curvula* n.gen., n.sp.; 4, *Lunulospora curvula* n.gen., n.sp.; 5, *Alatospora acuminata* n.gen., n.sp.; 6, *Articulospora tetracladia* n.gen., n.sp.; 7, *Tetracladium Marchalianum* De Wild.; 8, *T. setigerum* (Grove) n.comb.; 9, *Heliscus longibrachiatus* n.sp.; 10, *H. aquaticus* n.sp.; 11, *Clavariopsis aquatica* De Wild.; 12, *Lemonniera aquatica* De Wild.; 13, *Tricladium splendens* n.gen., n.sp.; 14, *T. angulatum* n.sp.; 15, *Tetrachaetum elegans* n.gen., n.sp.; 16, *aricosporium Elodeae* Kegel; 17-20, types of spore not identified, and fungi bearing them have not been found on the alder leaves or on other substrata. All $\times 280$.

present, and a species of *Actinomyces* is often to be seen, especially on leaves in an advanced stage of decomposition. On a single leaf it is not unusual to find eight or nine distinct species of aquatic Hyphomycetes, although frequently only two or three species occur on a

particular leaf. Although many hundreds of decaying alder leaves were taken from the stream in the leaf-skeleton condition and examined, at all periods of the year, only very rarely has one been seen which failed to yield any of these fungi. When the leaves were first examined in November 1940 sixteen species of aquatic Hyphomycetes were clearly recognized. During the following year although hundreds of leaves were examined, and although each of the sixteen species was encountered over and over again, no further species was added to the list.

Of the sixteen species six could be assigned to known species, namely, *Lemonniera aquatica* De Wild., *Clavariopsis aquatica* De Wild., *Tetracadium Marchalianum* De Wild., *Tridentaria setigera* Grove, *Varicosporium Elodeae* Kegel and *Fusarium longissimum* Sacc. & Syd. The rest appear to be new to science.

Thirteen of the sixteen species have been grown in pure culture, but in two only has spore formation occurred on agar. In most species grown on malt agar a compact colony is formed which fails to produce spores. When, however, a strip of this colony is submerged in sterile water, spore production occurs readily in twenty-four to forty-eight hours. Under these conditions the conidiophores develop from the old mycelium, and not from the marginal region of growing hyphae.

One of the chief features of interest in these fungi is the branched four-armed spore developed in so many species. The possible significance of this spore shape in the environment in which these fungi grow will be discussed later, but it is perhaps worth emphasizing at this point that the great difference in the development of the spore in the different genera strongly suggests that there is here a striking case of parallel evolution.

The development of the spore in most species has been followed using hanging-drop cultures. Because these fungi are aquatic and the spores are produced below water, they are particularly suitable objects in which to follow spore formation.

With one exception (Text-fig. 12) all the figures and photomicrographs have been prepared from living material. The text-figures were all drawn with the aid of a camera lucida.

As those species of the submerged alder-leaf flora which have already been described are, for the most part, very little known, a very brief description in English emphasizing the features of diagnostic importance is given at the end of the account of each fungus.

SPORE FORMS IN HYPHOMYCETES*

Before describing the individual fungi of the aquatic alder-leaf flora, it is first necessary briefly to discuss some of the types of spore encountered in Hyphomycetes.

* The quotations in this section are all from Mason (1933).

Vuillemin (1910) first drew attention to the clear distinction between thallospores and *conidia vera*, and the question of the nature of spore forms in Hyphomycetes and of Ascomycetes in the 'imperfect' state has, in recent years, been discussed critically by Mason (1933, 1937). Following Vuillemin, he recognized phialospores (*conidia vera*) as produced in basipetal succession from a phialide defined as a 'fusiform truncate, fusiform beaked, or acuminate terminal portion of a hypha, from the apex of which, or within which, thin-walled conidia are abstricted'. During its development the phialospore is not delimited from the phialide by a cross-wall, and a cleavage line separating the spore from its phialide is formed only when the spore is fully grown. Mason, again following Vuillemin, recognized thallospores as spores 'which are really part of the hypha bearing them' and 'when borne singly and terminally...represent the swollen end of a hypha and not a distinct structure formed *de novo*'. Vuillemin (1911) used the term *aleuriospore* for terminal chlamydospores (thallospores) which, together with phialospores, would be referred to by most mycologists as conidia. At an early stage in its development the aleuriospore is delimited from its parent hypha by a transverse wall. In addition to Vuillemin's types Mason (1933) suggested another, the *radulaspore*, in which 'each spore is borne on a little sterigma, without any reference to the growing-point of a hypha'. Amongst the best-known examples of radulaspores are the grape-like clusters of spores borne on little sterigmata on the conidiophore of *Botrytis cinerea*.

In Hyphomycetes (including Ascomycetes classified in their 'imperfect' condition) there is frequently more than one spore form in the life cycle. Thus *Botrytis cinerea* produces radulaspores and phialospores, *Acrospeira levis* (Wiltshire, 1938) aleuriospores and phialospores, but others such as *Penicillium* produce only phialospores. Some genera have been founded on thallospores (e.g. *Mycogone*, *Monilia*, *Acrospeira*, etc.), while others have been founded on phialospores (e.g. *Fusarium*, *Penicillium*, *Cephalosporium*, etc.). According to Mason (1933) even if thallospores or radulaspores represent the spore form typically developed by Ascomycetes in the 'imperfect' condition, a phialospore stage usually occurs as well. The distinction between radulaspores and phialospores may not always be very sharp, but that between thallospores and phialospores appears to be fundamental. It seems clear, therefore, that if two species of fungi, *A* and *B*, produce spores of the same characteristic shape, but in *A* they are aleuriospores while in *B* they are phialospores, *A* and *B* cannot, on the strength of the resemblance in shape of the spore, be included in the same genus. The agreement must be considered as due to chance or to parallel development.

In his later work (1937), Mason has stressed not only the difference between thallospores and phialospores but also the difference be-

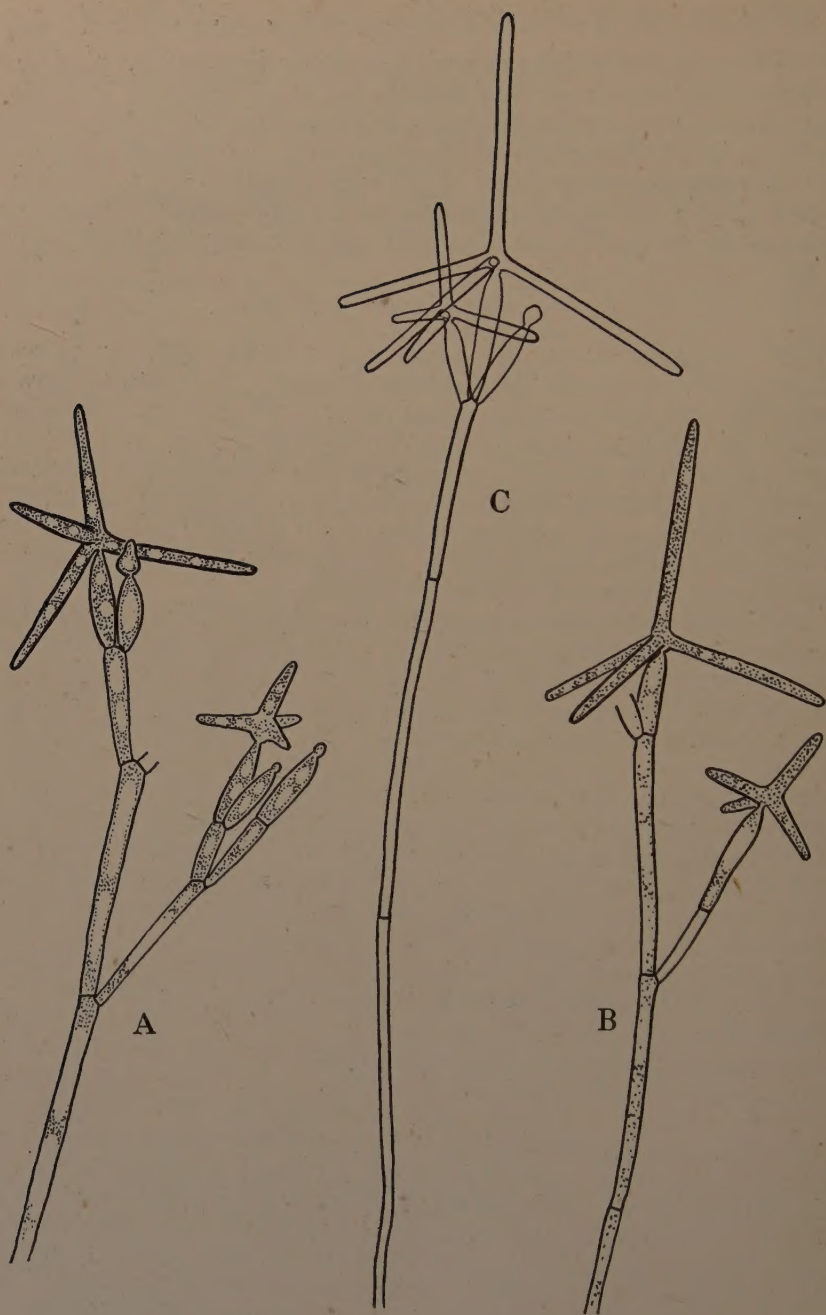
tween 'dry spores' which are capable of being dispersed by wind and 'slime spores' which are not suitable for wind dispersal. This biological classification of spore forms, if it leads to these features being noted in future descriptions of Hyphomycetes, is a valuable advance, but it seems that when fungi of the type described below are considered, a third biological spore type must be recognized, namely, the 'aquatic spore', produced, liberated and normally dispersed below water.

LEMONNIERA AQUATICA De Wild.

This beautiful fungus (Text-figs. 2, 3 and Pl. XII, fig. 1) was originally described by De Wildeman (1894). My material agrees perfectly with his description and figures. The fungus was found throughout the year growing on submerged decaying leaves of alder and willow. The conidiophore, which is a completely submerged structure, consists of a basal unbranched part, 100–500 μ long, which, towards its free end, branches to produce a group of phialides from which the conidia are abstricted. Occasionally the conidiophore is unbranched with a single terminal phialide.

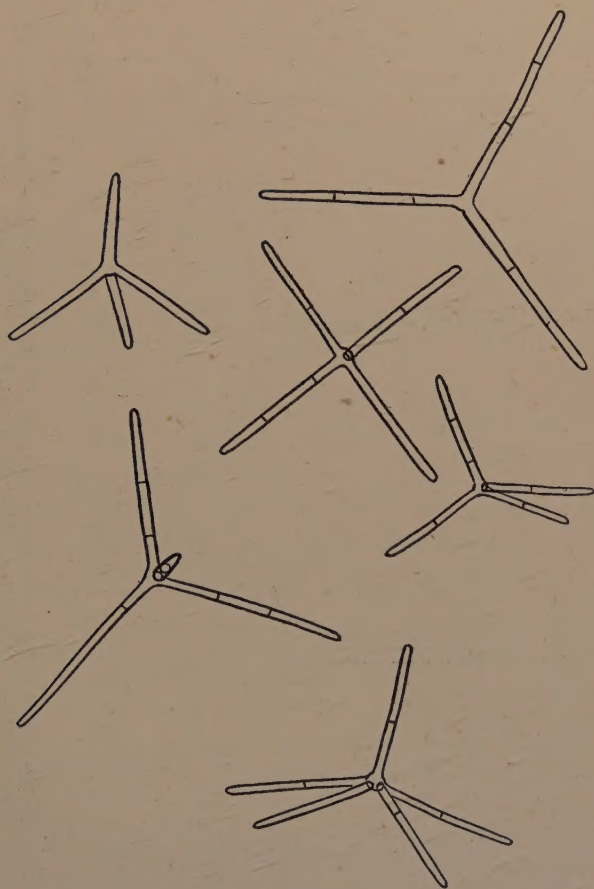
The spore (phialospore) starts its development (Text-fig. 4) as a small spherical swelling at the end of the phialide. This swelling becomes tetrahedral, and from the four corners of the tetrahedron the four arms of the spore develop simultaneously. During this development there is no cross-wall separating the spore from its phialide. Finally, however, a cleavage line forms separating the two, and a few minutes later the spore is shed. At the time of liberation the arms of the spore are usually non-septate; septa appear after liberation but before germination. Occasionally there are five divergent arms instead of four (Text-fig. 3), and once, in pure culture, a spore of three arms was observed. Immediately after the liberation of a spore a new one begins to form at the tip of the phialide.

The fungus was isolated in pure culture. The colony on malt agar is compact, consisting of branched septate hyphae. At the edge, the leading hyphae of the growing mycelium are 4 μ in diameter. In the older regions the hyphae aggregate to form mycelial cords in which there may be five or six strands of hyphae. In still older regions these cords turn bright, and finally dark brown due to a coloration of the cell walls. At first this happens at isolated points on the colony, but later the browning is general. When a colony (Plate XVI, fig. 3) about three weeks old is examined, there is a central zone which is entirely brown; outside this is a zone where small brown islands occur in the white mycelial mat, and beyond this is a third zone, including the growing margin, which is entirely white. When the old brown mycelial cords are examined it is found that the cells of many of the hyphae are much inflated so that the mycelium has a beaded



Text-fig. 2. *Lemmoniera aquatica* De Wild. A, B, and C, conidiophore. A and B from alder leaves; C from pure culture. Protoplasmic contents shown in A and B but not in C. $\times 466$.

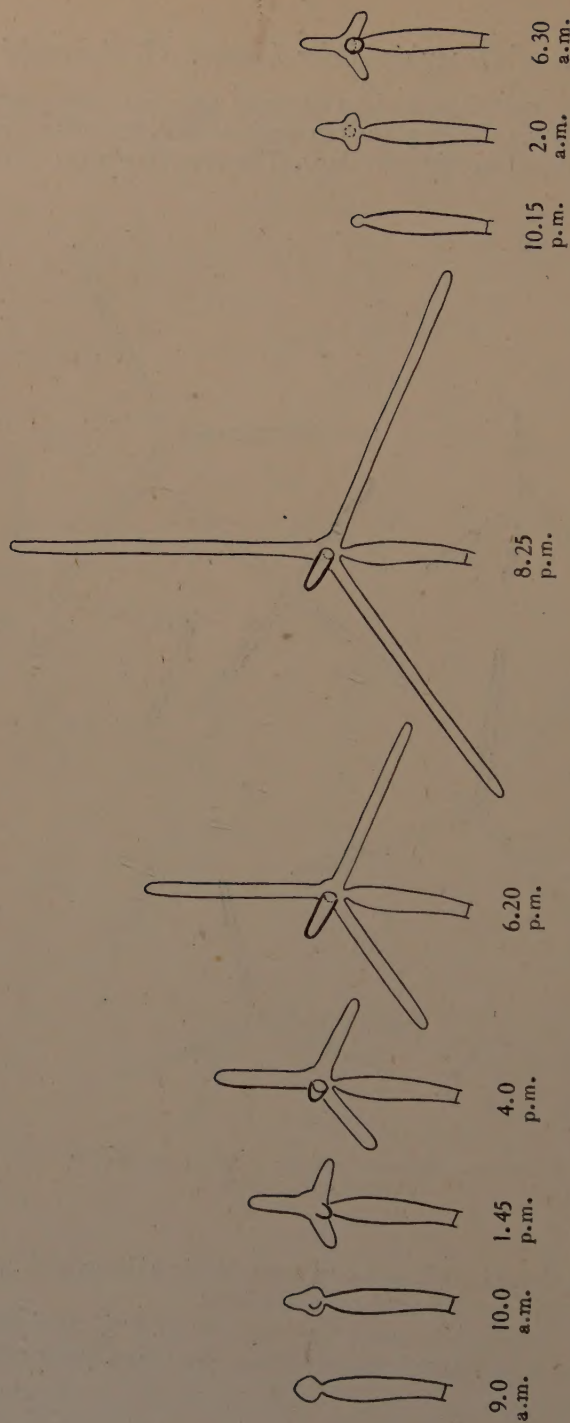
appearance. On malt agar and on oatmeal agar the colony produces no spores, but when a slice is placed in sterile water, abundant conidiophores are produced within two days. The conidiophores and spores



Text-fig. 3. *Lemonniera aquatica*. Spores developed in pure culture. $\times 350$.

formed under these conditions are completely submerged and agree perfectly with those produced on the leaves.

The spores germinate readily in water or in 2 % malt solution, a germ tube being produced usually from the tip of each arm of the spore.



Text-fig. 4. *Lemniera aquatica*. Single phialide drawn at intervals to show phialospore development. From hanging-drop pure culture. The first spore was shed between 8.30 and 9.0 p.m. $\times 630$.

Lemonniera aquatica De Wild.

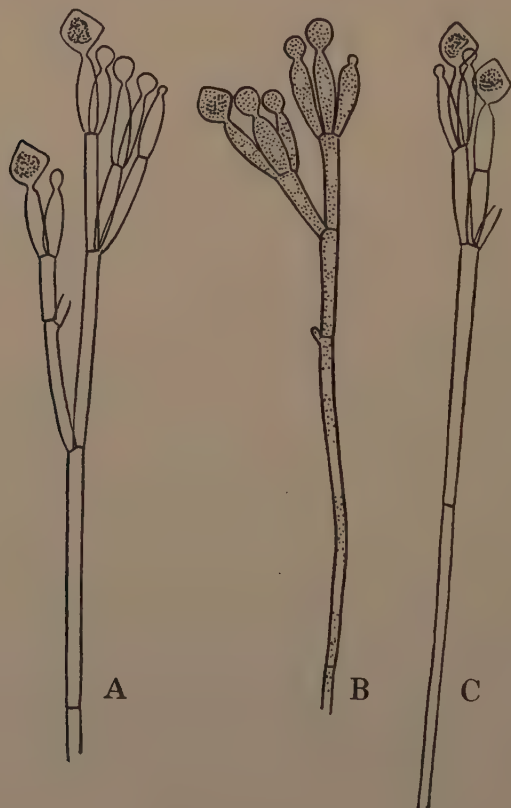
Submerged aquatic fungus with branched septate mycelium; conidiophore consisting of a straight unbranched portion which branches near its free end to form a group of two to eight phialides. Each phialide produces conidia (phialospores) in basipetal succession. Conidium consisting of four long divergent arms (which usually become septate), 20–70 μ long, 3–4 μ broad, and inserted on the phialide at the point of divergence of the four arms of the spore.

MARGARITISPORA AQUATICA n.gen., n.sp.

This fungus was found throughout the year on decaying leaves of alder and willow. The mycelium is branched and septate, occurring within the substance of the decaying leaves, particularly in the main veins and petioles. The conidiophore, formed below water, shows a striking resemblance to that of *Penicillium*. It consists of a straight unbranched lower part which branches near its apex to form a clump of usually six to ten phialides (Text-fig. 5 and Pl. XII, fig. 3). Occasionally the number is less, and rarely the conidiophore is simple with a single terminal phialide. The spores formed below water from the tips of the phialides are nearly spherical but usually somewhat tetrahedral, when mature bearing a marked similarity in shape to the pollen grains of hazel and birch. The spore is a phialospore and its development is shown in Text-fig. 7. In this example the conidiophore is simpler than usual, with only two phialides and the basal unbranched region is unusually short. The conidiophore has developed from one of the spherical cells of a sclerotium. The time taken for the complete formation of a phialospore is six to ten hours.

Except that the shape of the spore is different, the present species shows a close resemblance to *Lemonniera aquatica*. Indeed when De Wildeman (1894) originally described *L. aquatica* he remarked that it occurred in two forms, namely, (i) a form with spores each having four long divergent arms, and (ii) a form with round spores, and he claimed to have seen transitions between the two. He wrote 'on peut ainsi observer la transformation des conidies à quatre branches en conidies globuleuses. Cette transformation était des plus visible; au premier abord on aurait pu douter et croire qu'il y aurait lieu de créer pour ces formes deux noms spécifiques, j'ai pu parfois même sur une ombrelle observer de nombreuses formes de transition entre les conidies globuleuses et les conidies à quatre branches.' Later, however, after examining fresh sources of material, De Wildeman (1895) suggested that two different species were probably present, but he does not appear to have named his round-spored species, which, I think, is probably identical with the present fungus.

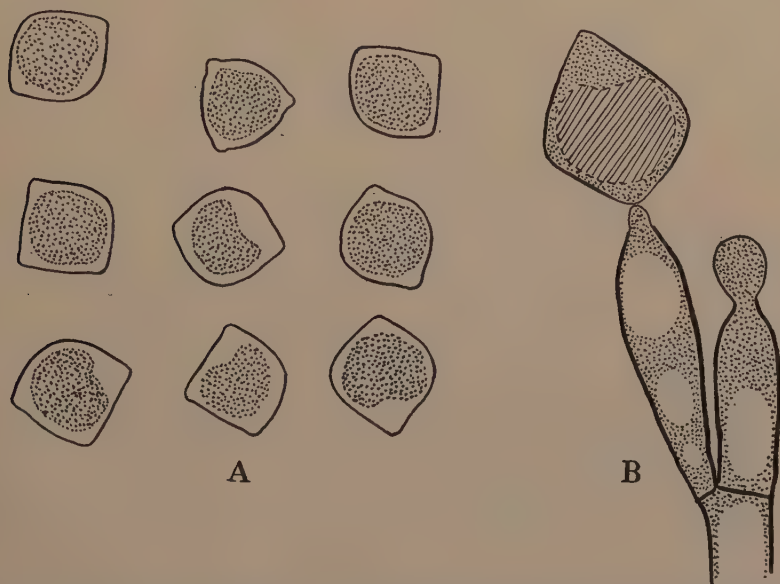
The fungus grows readily in pure culture giving rise to a compact white colony on malt agar, with a small amount of white superficial growth. When the culture is about two weeks old, small sclerotia (1–2 mm. diam.) make their appearance scattered over the colony (Pl. XVI, fig. 4). At first these are brown but later they turn almost black. The sclerotium consists of a pseudoparenchymatous mass of



Text-fig. 5. *Margaritispora aquatica* n.gen., n.sp. Three completely submerged conidiophores. In B the protoplasmic contents are shown; in A and C the glycogen masses are stippled, but no other contents are indicated. All from pure culture. $\times 466$.

nearly spherical cells. The colony on agar fails to form spores, but when a strip is submerged in water, conidiophores and conidia are produced, agreeing exactly with those developed on the alder leaves. The conidiophores arise both from the ordinary cells of the old mycelium and from the spherical cells of the surface of the sclerotium (Text-fig. 7).

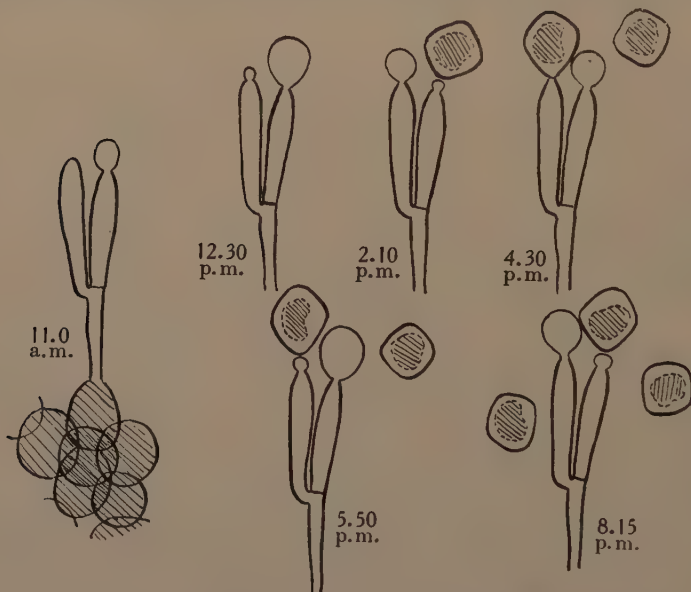
When a strip of culture on malt agar is submerged in deep water, the conidia are of the form described above (Text-figs. 5-7). However, when a strip is placed in very shallow water (0.5-1 mm. deep) conidiophores and spores of a different type are produced (Text-fig. 8). The long unbranched part of the conidiophore is formed in the water and lies beneath the surface, but the individual phialides curve up, due, probably, to positive aerotropism, and their tips pierce the surface film so that the whole conidiophore has a one-sided appearance. From the tips of the phialides which project above the



Text-fig. 6. *Margaritispora aquatica*. A, mature spores; the glycogen vacuoles are stippled. B, two phialides of a conidiophore; the glycogen vacuole of the mature spore is shaded and other protoplasmic contents are stippled. The spore on the left is mature and a new spore is just beginning to develop below it. Both from pure culture. A $\times 1226$, B $\times 1740$.

surface, spores are produced. These spores are elongated, usually slightly curved, commonly with a minute hilum at the point of attachment to the phialide, and, although they may not become septate until after liberation, each is finally three-celled with a glycogen vacuole in each cell. The spore is liberated on to the surface of the water. Sometimes, although not often, one or more phialides of a conidiophore formed in very shallow water may remain completely submerged, and these produce spores of the nearly spherical but slightly tetrahedral form, so that the two kinds of spore are formed on the same conidiophore. If a culture in shallow water is examined microscopically,

both completely submerged conidiophores and conidiophores with phialide tips projecting above the surface can be seen. If the spore accumulation from such a culture is then examined, both kinds of spore are to be seen, and, if careful search is made, all transitional forms can be found. However, these transitional forms are few compared with the unicellular spherical-to-tetrahedral spores formed below water, and with the three-celled elongated spores abstricted above the surface of the water. The two kinds of spore have been observed not only under laboratory conditions but also in nature.



Text-fig. 7. *Margaritispora aquatica*. The development of phialospores from the two phialides of an exceptionally short submerged conidiophore which has originated from one of the spherical cells of a sclerotium. A few of the dark cells of this sclerotium are shown in the drawing made at 11 a.m. In the spore the only contents indicated are the glycogen vacuoles which are shaded. From a hanging-drop mount of a pure culture. $\times 720$.

If in considering these aquatic Hyphomycetes possible connexion with the Ascomycetes could be ignored and we could set about constructing a 'natural' classification, there is little doubt that this fungus would find a place very close to *L. aquatica*. However, in the Hyphomycetes a natural classification seems out of the question, and all genera are merely 'form genera'. In his classification of the Hyphomycetes Saccardo gave an invaluable arrangement of 'form genera' on a purely artificial basis. This recognized in each of the families (Mucedinaceae, Dematiaceae, etc.), subfamilies based on spore shape (Amerosporae, Didymosporae, Phragmosporae, Staurosporae). In

the most recent arrangement of the Hyphomycetes, Wakefield and Bisby (1941), while rejecting Saccardo's families and substituting for them the two groups Gloiosporae and Xerosporae, retain Saccardo's arrangement in subfamilies on the basis of spore shape. The form of the spore in *L. aquatica* clearly puts that fungus into a 'Staurosporae'



Text-fig. 8. *Margaritispora aquatica*. A and B, conidiophores developed in very shallow water with phialides which pierce the surface. C, phialospores produced by such conidiophores. The glycogen vacuoles are shaded. From pure culture. $\times 540$.

subfamily, while the spherical or tetrahedral aquatic spore of the present fungus puts it into an 'Amerosporae' subfamily, although judged by the form of the spores produced on the surface of the water, a 'Phragmosporae' subfamily might be indicated. It seems clear, however, that while the genera of Hyphomycetes remain 'form

genera' the present species could not go into the same genus with *Lemonniera*. At first I thought that the difficulty could be solved by placing the fungus in the genus *Penicillium*, since structurally the only difference is that the spores of my fungus, though produced in basipetal succession, do not form chains, and this difference is clearly associated with the aquatic habit. However, it seems that, as one of the most outstanding biological features of the numerous species of *Penicillium* is the production of air-borne spores on aerial conidiophores, this should remain a characteristic of the genus. The best plan would therefore appear to be to make this fungus the type of a new genus. The pearly appearance of the spores, due to the abundant glycogen which they contain, has suggested the generic name.

✓ ***Margaritispora* n.gen.**

Aquatic fungi with branched, septate, mycelium. Conidiophore like that of *Penicillium*, but submerged. Phialospores spherical, tetrahedral or broadly fusiform, produced in basipetal succession from the phialides, but not forming chains.

✓ ***Margaritispora aquatica* n.sp.**

Aquatic fungus with branched, septate, hyaline mycelium. Colony on malt agar white, dotted with small, dark brown to black sclerotia. Conidiophore, usually branched in a manner resembling that of *Penicillium*, consisting of a straight part 100–200 μ long, 3–45 μ wide, branching near its upper end to form a group of two to ten phialides. In relatively deep water, conidiophore completely submerged and spores formed below water. These phialospores, produced in basipetal succession but not remaining together in chains, are tetrahedral to subspherical, 10–13 μ diam. with a conspicuous glycogen vacuole. When conidiophores are formed in very shallow water the phialides curve up, their tips pierce the water and liberate aerial spores on to the surface. These phialospores are elongate or broadly fusiform, 20–30 μ long, 6–8 μ wide, usually three-celled with a glycogen vacuole in each cell.

Hab. On decaying leaves of *Alnus glutinosa* and *Salix* sp. from a stream in Leicestershire, England.

Margaritispora gen.nov.

[Gr. *μαργαρίτης*, a pearl, from the pearl-like appearance of the spores.]

Fungi aquatici, mycelio repente, septato, ramoso. Conidiophora ut in genere *Penicillio* ramosa, sed submersa. Phialosporae hyalinae, biformes, sub aqua efformatae continuae subglobosae vel quadrangulatae, in aere late fusiformes, 2-septatae, deinceps e phialidibus evolutae sed non catenulatim adherentes.

Margaritispora aquatica sp. nov.

Fungus aquaticus, mycelio hyalino repente, septato, ramoso. Conidiophora hyalina ad apices ramosa, 2–10 phialides gerentia. Conidia (phialosporae) hyalina, deinceps evoluta sed non catenulata, biformia, alia submersa subglobosa vel quadrangulata, continua, 10–13 μ diam., guttulis conspiculis glycogenis praedita, alia in aere evoluta elongata vel late fusiformia, 20–30 μ longa, 6–8 μ lata, plerumque 2-septata, in quaque cellula guttula glycogena praedita. In culturis in agaro ('malt agar') adsunt sclerotia parva, atrobrunnea vel nigra.

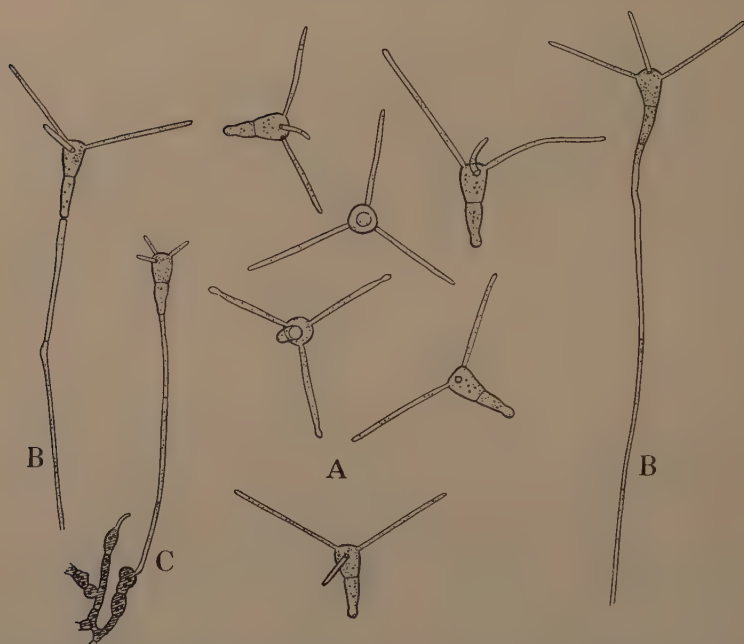
Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

CLAVARIOPSIS AQUATICA De Wild.

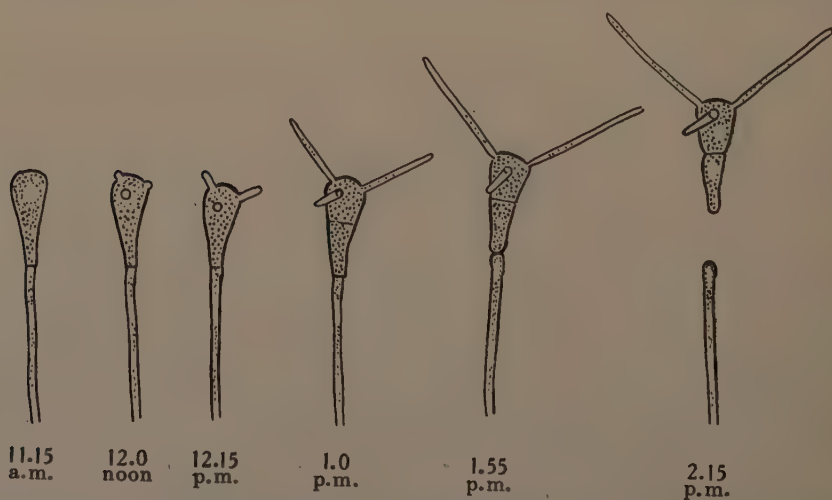
This very characteristic fungus (Text-fig. 9 and Pl. XII, figs. 6, 7) was described by De Wildeman in 1895, but I have been unable to find any record of later date. I have found it all the year round growing abundantly on submerged decaying leaves of alder and willow. The conidiophore is usually unbranched 50–200 μ long and the conidium is terminal. In development (Text-fig. 10) the tip of the conidiophore swells up, becomes club-shaped, and this swelling, which is the spore primordium, is delimited from the conidiophore by a cross-wall. When the main body of the spore is fully grown, three narrow diverging arms develop from its crown growing out simultaneously. During this development the spore becomes two-celled by the formation of a cross-wall. Very shortly after the narrow arms are fully grown, the spore separates from the sporophore with a little jerk, due to the sudden rounding off of the two layers of the cross-wall where the spore meets the conidiophore. In Vuillemin's nomenclature the spore is clearly an aleuriospore.

Although De Wildeman followed the development and disjunction of the spore, he did not observe its germination, and so was not prepared to state that the body was a spore. In my material the spores germinate very readily either in water or in 2 % malt solution (Text-fig. 11). The mature spore bears four divergent arms of which one is relatively fat and two-celled while the other three are narrow, longer and usually non-septate. On germination, germ tubes develop from the tips of each or any of the four arms.

The fungus grows well on malt agar or on oatmeal agar. On malt agar the colony is compact, dark olive-green in the older parts, but with an irregular white fringe (Pl. XVI, fig. 5). There is much growth of white aerial hyphae over the whole surface of the colony. No aleuriospores are produced on solid media, but when a strip of a colony on agar is transferred to sterile water, spores are developed



Text-fig. 9. *Clavariopsis aquatica* De Wild. A, aleuriospores; B, conidiophores with fully grown spores; C, a conidiophore arising from a cell of the old mycelium and with a terminal spore in which the three narrow arms are not yet fully grown. All from pure culture. $\times 285$.



Text-fig. 10. *Clavariopsis aquatica*. The development of an aleuriospore. Specimen growing on a submerged alder leaf. $\times 466$.

within twenty-four hours, and these agree exactly with those formed on the leaves, and, like them, are produced only below the surface of the water. The conidiophores arise from the inflated, oil-containing, dark-coloured cells of the old mycelium (Text-fig. 9).

A number of separate single-spore isolations of this fungus have been made from submerged decaying leaves of alder at different times of the year. These all agree in general cultural characters, but differ in the fact that some isolations produce pycnidia while others

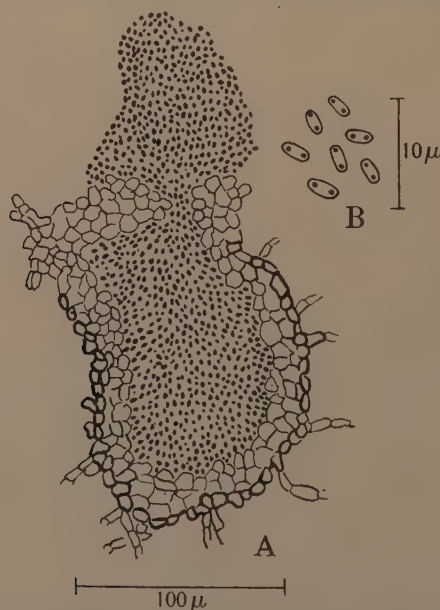


Text-fig. 11. *Clavariopsis aquatica*. Spore germinating in water. *a* and *b* are appressoria formed by the tips of certain hyphae in contact with the glass of the dish. Germ tubes have developed from the tips of three of the four arms of the spore. The narrow arm on the left has failed to produce a germ tube. $\times 286$.

do not. In cultures of the former kind, colonies on malt or oatmeal agar, three or four weeks old, have very numerous little black dots 50–200 μ in diameter scattered over the central area of the colony. Serial sections show that some of these are sclerotia and others are pycnidia, but there does not seem to be any sharp dividing line between the two. These bodies are irregular in shape. They are often approximately spherical but, tending to arise in groups, they are frequently confluent. In a pycnidium the wall is several cells thick, the cells of the outermost layer having blackened walls. Within the pycnidium

there are no definite phialides, but conidia are apparently budded off from the thin-walled cells forming the lining layer of the pycnidium. The whole pycnidium becomes filled with a mass of spores which ooze out through the irregular ostiole (Text-fig. 12). The spores are oval, $3 \times 1 \mu$, and each has two small oil-drops. So far, attempts to germinate them have failed.

When it was found that certain isolations of the fungus produced pycnidia and sclerotia on agar while others did not, it was felt that there was the possibility of the pycnidia belonging to a contaminant growing together with *Clavariopsis aquatica*. Accordingly, from such a



Text-fig. 12. *Clavariopsis aquatica*. A, section through a pycnidium. From a microtomed section. The outlines have been drawn with camera lucida but not the individual spores. B, living pycnidiospores. Both from pure culture. A, $\times 280$; B, $\times 1400$.

colony twelve separate single-aleuriospore cultures were made, each of which in due course produced pycnidia.

Holtermann (1898) used the name '*Clavariopsis*' for a genus of gelatinous Basidiomycetes with the single species *C. pinguis*. De Wildeman's name is, however, earlier (1895) and must be retained.

Clavariopsis aquatica De Wild.

Submerged aquatic fungus with branched, septate mycelium. Conidiophore usually simple, $50-250 \mu$ long, $2-2.5 \mu$ broad. Conidium (aleuriospore) terminal consisting of a broadly clavate, two-celled,

main part, 30–40 μ long, 3–4 μ broad at the base widening to 12–14 μ broad at the apex, with three long divergent processes 50–70 μ long, 1.5–2 μ , broad developed from its truncate apex.

HELISCUS AQUATICUS n.sp.

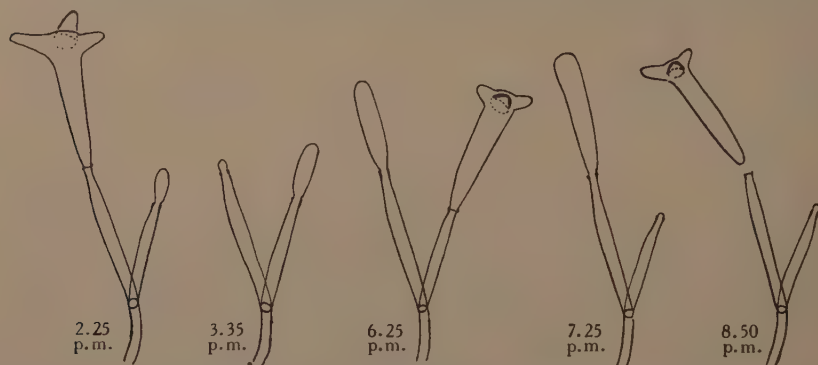
This fungus (Text-figs. 13, 14, Pl. XII, figs. 8–11) was often observed throughout the year growing on submerged decaying leaves of alder in the stream bed. It is one of the rarer members of the alder-leaf flora. It has been grown in pure culture.

A mycelium of branched septate hyphae is formed within submerged alder leaves. From this, simple or sparingly branched conidiophores project a short distance (usually 40–50 μ) into the water. The branches terminate (Text-fig. 13) in phialides, from each of which spores are abstricted in basipetal succession. The spore starts its development as a small swelling at the end of the phialide. This soon becomes more or less cylindrical and finally rather clavate, 28–40 μ long, widening from 3 μ at the base to 5–6 μ at the apex. Then, from the truncate apex three short, blunt divergent processes 3–8 μ long and approximately 3 μ broad grow out simultaneously. Only when the spore is fully grown does a cleavage line develop separating the protoplasm of the spore from that of the phialide. Very shortly after this the spore is liberated into the water, and at once a new spore begins to form at the end of the phialide. The shape of the mature spore is very like that of a clove. When liberated the spore is unicellular, but soon a cross-wall appears, dividing it into two cells.

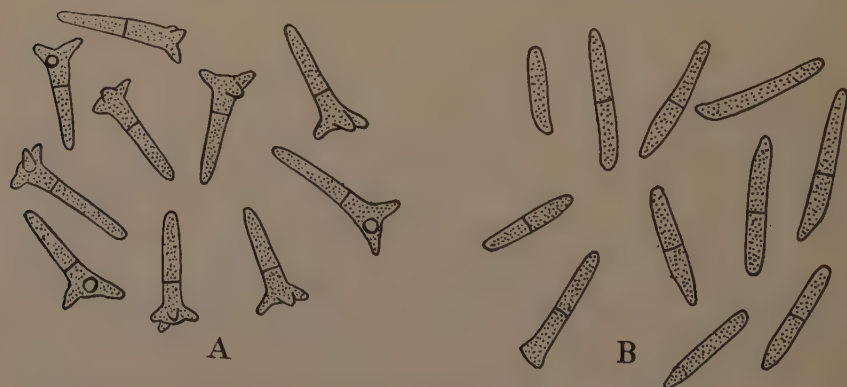
On malt agar, the fungus forms a compact colony of branched septate hyphae which grows much more quickly than any of the other species of alder-leaf fungi which have been studied in pure culture. The colony is brown with much pale brown aerial mycelium (Pl. XVI, fig. 7). During the first few weeks of its growth it produces no spores. When, however, a slice of a young colony is placed in deepish water so that the fungus is completely submerged and the developing conidiophores cannot reach the surface, conidia of the type found on the submerged alder leaves are developed. When a slice of a sterile colony is transferred to shallow water, some of the conidiophores develop below the water and form spores of the type described above, but the tips of others pierce the surface film of water and produce their spores aerially. These spores are of a different form. The three processes fail to develop from the apex of the spore, so that instead of being clove-shaped it is more or less rod-shaped (Text-fig. 14). If a Petri dish of sterile water containing a slice of colony which has been transferred to it two or three days previously is examined under the microscope, numerous conidia of the four-armed, submerged type, can be seen at the bottom of the dish, while at a higher focus, floating on the surface

of the water, the simple rod-shaped conidia, produced aerially, can be observed (Pl. XII, fig. 10).

Although for the first few weeks a colony on malt agar fails to form spores, as the culture ages (four to five weeks) spore production occurs. In this process small dark brown sclerotium-like bodies 0.3–1.0 mm. in



Text-fig. 13. *Heliscus aquaticus* n.sp. Conidiophore with two phialides in a hanging-drop of water. Drawn at intervals to show phialospore development. The spore on the left-hand phialide at 2.25 p.m. was almost ripe, being shed without further growth at 2.45 p.m. The spore on the right-hand phialide which is figured in a full-grown condition at 6.25 p.m. was shed at 6.30 p.m. From pure culture. $\times 620$.



Text-fig. 14. *Heliscus aquaticus*. A, spores formed below water; B, spores formed aerially by phialides which pierced the water surface. Both sets of sketches represent random selections from the same pure culture. $\times 466$.

diameter and of irregular shape are formed below the surface of the agar. They finally become erumpent, and from the exposed surface of the sclerotium very numerous conidiophores are produced clumped together to form a sporodochium. The net result of the activity of these conidiophores is to produce on each sporodochium a glistening white globule (0.5–3.0 mm. in diameter) of sticky spores in a watery

matrix. These spores (Pl. XII, fig. 11) are mostly of the simple form similar to those produced by phialides which emerge above a water surface. However, some spores show an incipient development of the three divergent arms from the apex and so tend towards the aquatic type of spore. The spores from the sporodochium are usually two-celled, but some are four-celled, due to the formation of an extra wall in each half of the spore.

It was at first thought that this fungus was a species of *Clavariopsis*, since in it and in *C. aquatica* the aquatic spore consists of a more or less clavate two-celled main axis from the crown of which three divergent processes develop, growing out simultaneously. It is true that these processes are long and narrow in *C. aquatica* and short and rather broad in the species under consideration, but the general construction of the spore is very similar in the two fungi. However, in one species (*C. aquatica*) the spore is an aleuriospore, while in the other it is a phialospore. As explained earlier (p. 342) it is unjustifiable, on the basis of the similarity of spore shape, to include the two fungi in the same genus.

The aquatic spores of this fungus show a striking resemblance to those of *Heliscus lugdunensis* Sacc. & Therry, a fungus found growing on pine bark (Saccardo, 1880). It is not clear if the spores of *H. lugdunensis* are phialospores, for details of development are not given, but from the published figures it would seem quite likely. The spores of *H. lugdunensis* were four-celled, and this difference and the striking difference in habitat suggests that the alder-leaf fungus should be referred to a new species of *Heliscus*. It must be emphasized, however, that inclusion in the genus *Heliscus* is only tentative, and a satisfactory conclusion can only be reached when these two species are grown in parallel pure culture.

***Heliscus aquaticus* n.sp.**

Mycelium branched, septate, hyaline at first, but becoming pale brown later. Conidiophore short, 20–50 μ long, simple, terminated by a single phialide, or branched to form a group of two to four phialides. Conidia (phialospores) produced in basipetal succession. When formed below water each conidium consists of a main rod-like, two-celled part 28–40 μ long, 4–5 μ broad, with three short blunt divergent processes, 3–8 μ long, 3 μ broad, developed from its apex. When formed above water from phialides which pierce the surface, each spore is simple, two-celled, rod-shaped, 25–40 μ long, 4–5 μ broad *without* the divergent processes. Sporodochia formed in old pure cultures on malt agar, producing spores, mainly of the rod-shaped type, in sticky, drop-like masses.

On decaying leaves of *Alnus glutinosa* from a stream in Leicestershire, England.

✓
Heliscus aquaticus sp. nov.

Fungus aquaticus submersus, mycelio repente primo hyalino demum pallide brunneo, septato, ramoso. Conidiophora hyalina breviter 20–50 μ longa, simplicia vel apice 2–4 phialides gerentia. Conidia (phialosporae) acrogena, hyalina, ex eodem loco deinceps exorientia, sub aqua evoluta clavata, 28–40 μ $\times$ 4–5 μ , 1-septata, apice processibus tribus conicis 3–8 μ $\times$ 3 μ ornata, supra aquam efformata cylindrica, utrinque attenuata, sine processibus, continua vel 1-septata, 25–40 μ $\times$ 4–5 μ . In cultis in agaro ('malt agar') vetustis adsunt sporodochia, conidia cylindrica in massulis glutinosis efferenda.

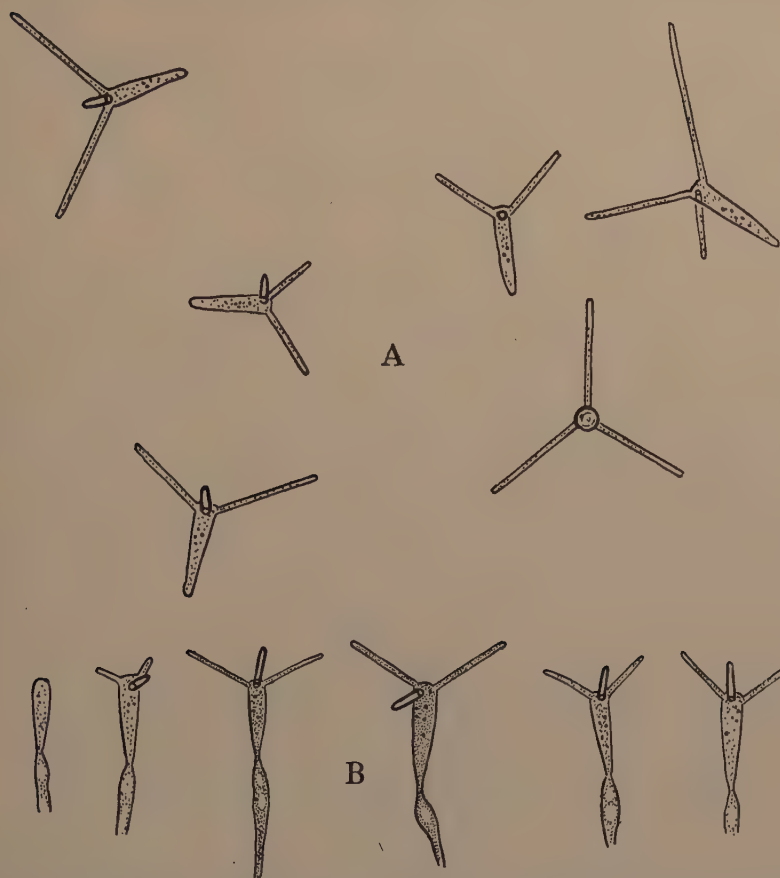
Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

HELISCUS LONGIBRACHIATUS n.sp.

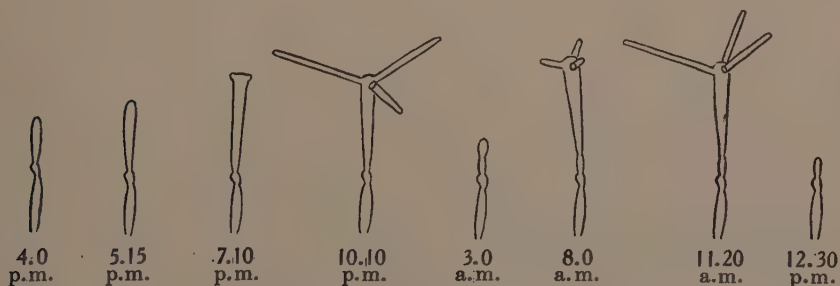
This fungus (Text-figs. 15, 16 and Pl. XIII, figs. 6, 7) was found, often abundantly, on decaying submerged alder leaves throughout the year. However, it was most plentiful in the autumn and showed a preference for the margins of the leaves, being found much less frequently on the petioles and larger veins where the other aquatic alder-leaf Hyphomycetes reach their richest development. The similarity in construction of the spore of *Clavariopsis aquatica* and *Heliscus aquaticus* has already been noted. In the present species the resemblance to *Clavariopsis aquatica* is still more striking, since the three divergent processes, developed from the crown of the wedge-shaped, first-formed arm of the spore, are long and narrow. Indeed, the mature spore, except in its unicellular character, looks remarkably like a small spore of *C. aquatica*.

Although *Heliscus longibrachiatus* is so common, and although repeated attempts have been made, it has not yet been isolated in pure culture. The conidia germinate readily in water.

The branched septate mycelium in the leaf gives rise to short, straight, simple conidiophores which grow out at right angles to the surface of the submerged leaf (Text-fig. 15). The conidiophore, which is usually 10–30 μ long, ends in a single phialide which itself forms the whole, or most of the conidiophore. From this, spores are abstricted in basipetal succession (Text-fig. 16). The spore begins its development at the end of the phialide as a minute swelling which becomes cylindrical and finally wedge-shaped with a truncate apex from which three narrow divergent processes grow out simultaneously. As soon as the spore is fully grown it is abstricted and a new spore begins to form. Sometimes this may form directly from the tip of the phialide, but sometimes a new sterigma (phialide tip) is differentiated before the next spore is produced.



Text-fig. 15. *Heliscus longibrachiatus* n.sp. A, spores; B, conidiophores: in the left-hand one the conidium has not yet developed its three narrow arms. From alder leaves. $\times 720$.



Text-fig. 16. *Heliscus longibrachiatus*. A single conidiophore consisting of a single phialide showing the development of spores in basipetal succession. After the production of the first spore a new sterigma was formed before the next phialospore began to develop. From hanging-drop culture. $\times 720$.

The present species differs from *Heliscus aquaticus* in the unicellular character and smaller size of the spore, and in its possession of three long and narrow divergent arms developed from the crown of the main wedge-shaped part of the spore, instead of the three short, broad, divergent processes of the spore of *H. aquaticus*. The grounds for including the two species in the same genus are that in both the general plan and development of the submerged phialospore are essentially the same.

✓
***Heliscus longibrachiatus* n.sp.**

Aquatic fungus with branched, septate mycelium. Conidiophores and conidia developed below water. Conidiophore usually simple consisting of a single phialide $10-20\mu$ long, 3μ broad. Conidium (phialospore) consisting of a clavate main part, $15-20\mu$ long, 1.5μ broad at the base widening to 4.0μ at the apex, with three straight divergent arms $15-25\mu$ long, $1.0-1.5\mu$ broad arising from the truncate apex. Conidia unicellular, produced in basipetal succession.

On decaying leaves of *Alnus glutinosa* from a stream in Leicestershire, England.

Heliscus longibrachiatus sp.nov.

Fungus aquaticus, sine sporodochiis, mycelio hyalino repente, septato, ramoso. Conidiophora conidiaque omnino submersa. Conidiophora hyalina plerumque simplicia, una modo phialide $10-20\mu$ longa, 3μ lata composita. Conidia (phialosporae) hyalina ex eodem loco deinceps evoluta, clavata, continua, $15-20\mu$ longa, basi 1.5μ lata, apicem versus ad 4μ incrassata, appendiculis tribus cylindricis elongatis $15-25\mu \times 1.0-1.5\mu$ apice truncato affixis.

Hab. In foliis putrescentibus *Alni glutinosae* in flumine jacentibus, Leicestershire, Anglia.

Obs. Ab *H. lugdunensi* Sacc. conidiis continuis longi-appendiculatis, a *Clavariopsis* De Wild. conidiorum ortus modo (phialosporae vice aleuriosporae) differt.

***TETRACLADIUM MARCHALIANUM* De Wild.**

This species, the type of its genus, was founded by De Wildeman (1893) on a collection of aquatic fungal spores very like the collection which I have found in the stream draining Cropston Reservoir. Some of the forms figured by De Wildeman appear to have already been described by Reinsch (1888) as varieties of the plankton alga *Cerasterias raphidioides* Reinsch (1869). This confusion has persisted in certain quarters until quite recent years, and the history of this remarkable muddle has been discussed in detail by Karling (1935).

De Wildeman recognized that his collection of conidia, found amongst vegetable debris in a pond, probably represented a mixture

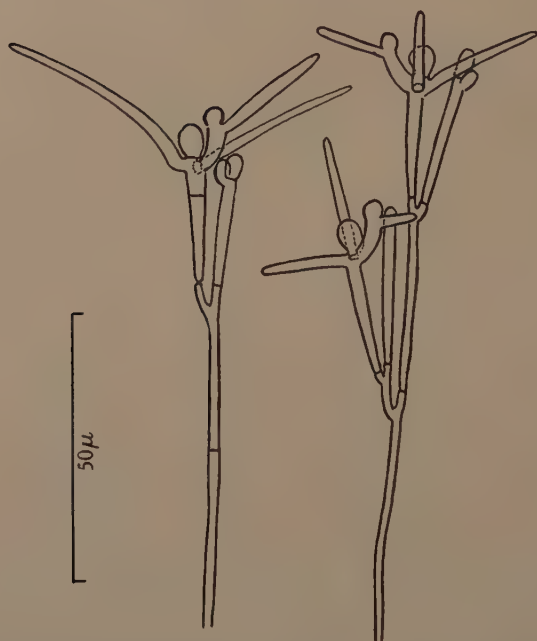
of several species. In his original illustrations of *Tetracladium Marchalianum* he figured spores belonging to both *Clavariopsis aquatica* and *Lemonniera aquatica*, two new species which he later (1894, 1895) described. De Wildeman redescribed *Tetracladium Marchalianum* in 1894 and this time figured conidia attached to conidiophores, but he also figured some conidia not attached, and my own work on these fungi leads me to the view that some of these belonged to other species.

De Wildeman later (1895) returned to the subject of *T. Marchalianum*, describing as a form of the species a fungus which seems to be entirely different from any of the fungi which were embraced either by his first (1893) or his second (1894) accounts.

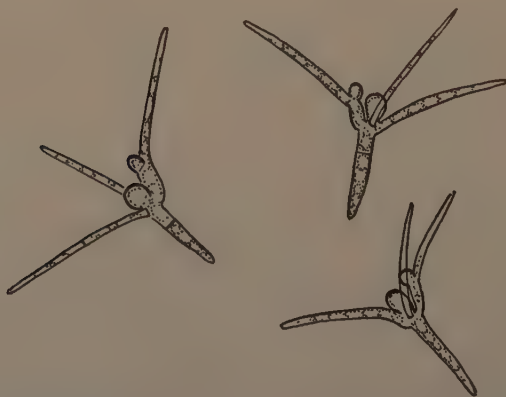
It seems best to retain the original name for the fungus which he figured with spores attached to conidiophores in 1894 and an undoubted spore of which was also illustrated as Fig. 1 in his original (1893) plate. If *T. Marchalianum* is limited in this way, the spore, developed under natural conditions, has normally four long divergent arms and, in addition, two spherical or oval knobs, one situated just above the point of divergence of the four arms of the spore, and the other a short distance away along one of the divergent branches (Text-figs: 17, 18 and Pl. XIII, fig. 3).

This fungus is one of the most abundant members of the fungus flora of the decaying submerged alder leaves. It was found throughout the year, but was especially abundant in June and July when it was the dominant member of this flora. I have also seen it frequently on decaying submerged leaves of willow. The branched septate mycelium is in the tissue of the decaying leaf, and the conidiophores, which are completely submerged structures, grow out at right angles to the substratum.

The fungus has been isolated on many occasions in pure culture. On malt agar a compact colony is formed (Pl. XVI, fig. 6). This is white to pale yellow, zoned, and there is a considerable low growth of white superficial mycelium. When grown in Petri dish cultures it usually fails to form spores. If, however, a strip of such a sterile culture is submerged in water, abundant conidiophores are produced within twenty-four hours. The general structure of these agrees with that of the conidiophores found on the alder leaves in nature, but the form of the spore shows a wide variation. This is illustrated in Text-fig. 19, in which, however, all the observed forms of spore have not been included. Nevertheless, the commonest type is that with four divergent arms and two knobs, which is almost always developed in nature on the alder and willow leaves. When a culture on oatmeal is used in place of one on malt, the same range of spore shape is produced, and the many separate isolations which have been examined all behave after this fashion. In this production in artificial culture of a large number of abnormal spores showing a wide variation in



Text-fig. 17. *Tetracadium Marchalianum* De Wild. Two conidiophores from submerged alder leaves. That on the left bears two conidia, the left-hand one being on the point of liberation; the right-hand spore is much younger. The right-hand conidiophore is similar but is more branched and bears two pairs of conidia, with, in each pair, a nearly ripe spore forming the left-hand member of the pair. $\times 700$.



Text-fig. 18. *Tetracadium Marchalianum*. Three conidia from the fungus growing on alder leaves. $\times 466$.

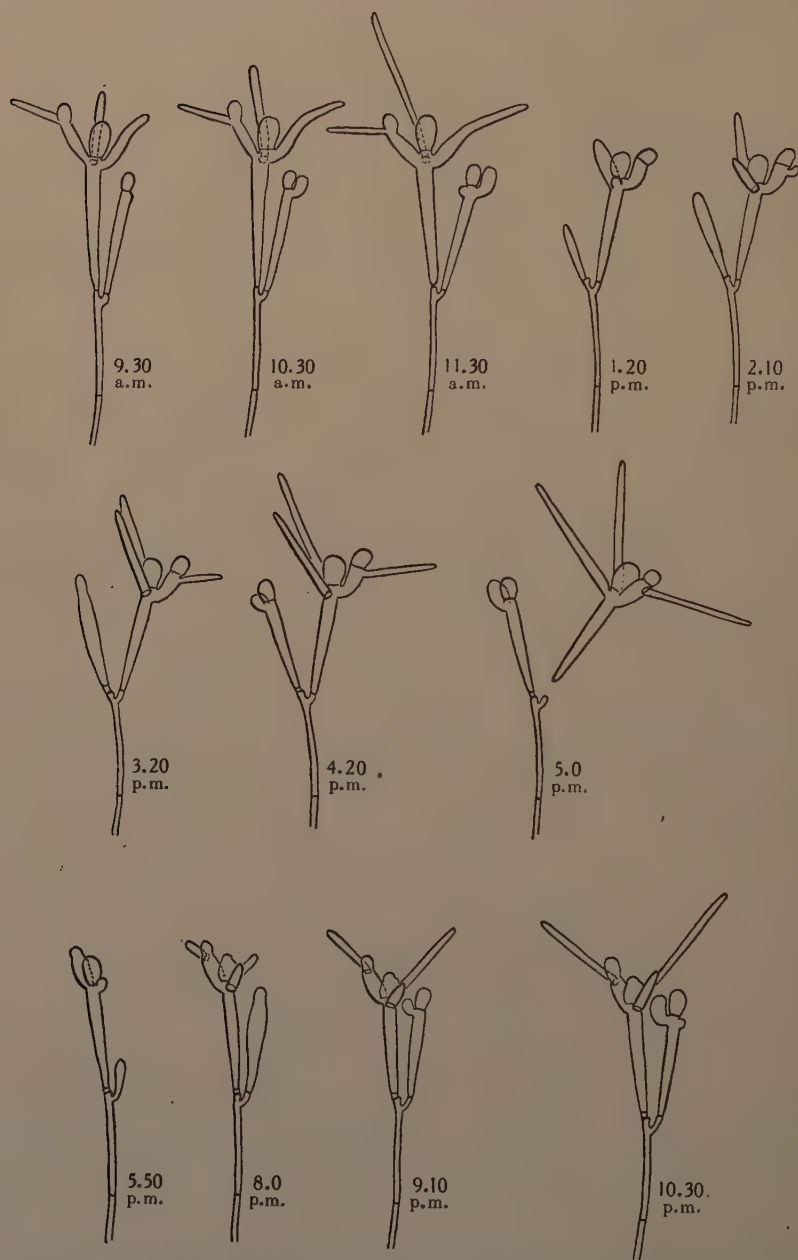
form, *T. Marchalianum* differs sharply from the other aquatic Hyphomycetes on alder leaves which have been cultured, for in these the forms of the spores, produced when a slice of colony is submerged in water, agree with those found in nature.

In Petri-dish cultures on malt agar spore formation is rare. In test-tube slopes on malt agar, however, spore production usually occurs, unless the culture dries too quickly, after four or five weeks. The spores accumulate at a few points on the culture in little sticky heaps about 1 mm. in diameter, and there is the same wide range of abnormal forms as is produced from a slice of colony submerged in water.



Text-fig. 19. *Tetracladium Marchalianum*. Range of spores developed from a slice of a culture on malt agar submerged in water. $\times 466$.

In nature the conidiophore arises as a straight branch from the vegetative mycelium in the decaying leaf. The end of this is cut off by a cross-wall, forming a long cell which is the spore primordium. Then, near the apex of this, a cross-wall is formed differentiating a little apical knob from the first-formed 'arm' of the spore (Text-fig. 20). Soon afterwards, just below and to one side of this cross-wall, a protuberance appears which is the beginning of the second arm of the spore, which, as it grows, bends upwards so that it is parallel with the apical knob. In the meantime on the other side of the apical knob, and again just below its limiting cross-wall, another protuberance begins to grow out which is destined to become the third arm of the



Text-fig. 20. *Tetracladium Marchalianum*. A conidiophore drawn at intervals over a period of thirteen hours showing the manner of spore development. From a hanging-drop culture of the fungus growing on a decaying alder leaf. $\times 540$.

spore. At about this stage the developing spore looks like a trident with three short, blunt prongs. The end of the second arm of the spore is now cut off by a cross-wall to form the second knob of the spore, and just below this cross-wall a new growing point is differentiated and begins to grow. Thus the second arm of the spore, the arm bearing the second knob, shows a kind of sympodial development and is not the result of the straight growth of a single hypha. Soon after the second knob is differentiated, the fourth arm of the spore makes its appearance as a new growing point differentiated just below the apical knob. By the growth of the arms the mature spore is soon produced consisting of its four divergent arms, formed in succession, and its two knobs.

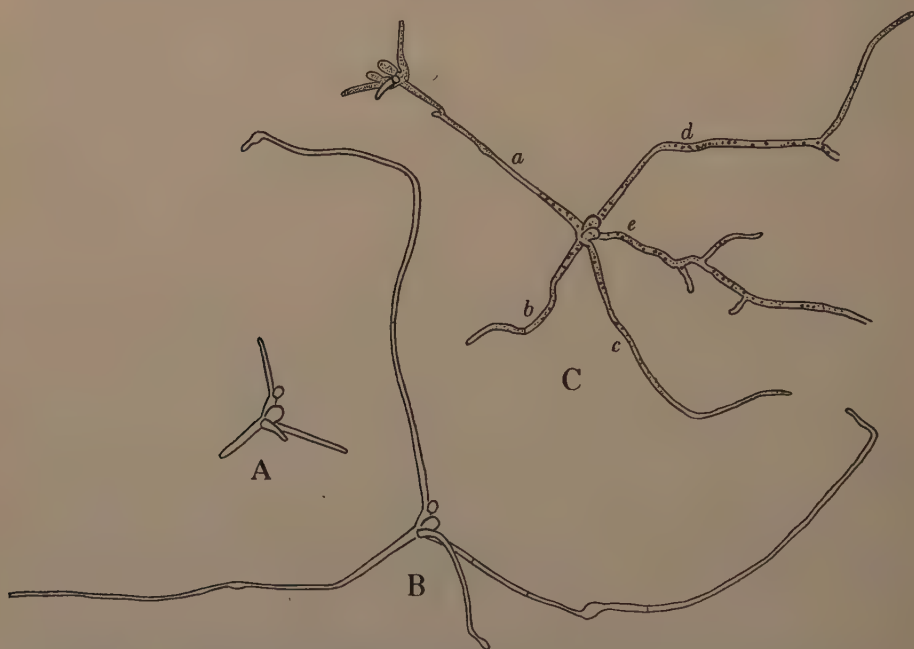
While the developing spore is still young, usually when its first arm is beginning to grow out, the conidiophore gives rise to a branch a short distance below the first spore. This branch is soon cut off by a wall near its base and is the primordium of a new spore.

As soon as the first spore is fully grown, it is liberated from the conidiophore, apparently by the solution of the middle lamella separating the spore from its conidiophore. Then, while the second spore is developing, a new hypha grows out from the stump from which the first has separated. This usually arises slightly to one side of the apex of the stump. It is soon cut off by a cross-wall and is the primordium of the third spore. In this way, with little or no further growth of the conidiophore, a number of spores may be produced from it. At any time there are usually two spores present at the end of the conidiophore, but at different stages of development. This is illustrated in Text-figs. 17 and 20 and in Pl. XIII, fig. 3. In Text-fig. 20 it is interesting to note that the condition at 10.30 a.m. is roughly the mirror image of the state of affairs at 4.20 p.m., but that at 9.10 p.m. an appearance essentially like that at 10.30 a.m. is again produced. This kind of conidiophore, in which two developing conidia are usually present at any one time, is by far the most frequent type which I have seen in nature, but branched conidiophores are not uncommon (Text-fig. 17).

The spore is clearly an aleuriospore. It germinates readily (Text-fig. 21) in water or in such a food solution as 2 % malt. The germ tubes usually arise from the tips of the branches, but sometimes from the knobs or from the neighbourhood of the knobs. Once a germinating spore was seen which had produced five germ tubes, one of which had developed into a conidiophore bearing a conidium (Text-fig. 21 C).

T. Marchalianum, as limited above, appears to have been observed by a number of investigators. Printz (1914) figured typical conidia, with the two characteristic knobs, but identified them as algae and referred them to Reinsch's algal genus *Cerasterias*. He considered that

this genus was embraced by an earlier algal genus founded by Kützing so that the name became *Asterothrix raphidioides* (Reinsch) Printz. Karling (1935) described a fungus and identified it as *Tetracladium Marchalianum*, but this seems to be a different, though closely related species, which will be considered below. Brutschy (1927) gave an account of *T. Marchalianum*, but I have been unable to see a copy of his paper. Barnes and Melville (1932) recorded *T. Marchalianum* for England without, however, giving any figures, but Dr Barnes tells



Text-fig. 21. *Tetracladium Marchalianum*. A, spore in 2% malt solution; B, same spore twenty-four hours later; C, germinating spore, in water, which has given rise to germ tubes *a*, *b*, *c* and *d* from the tips of the four divergent arms and a fifth germ tube (*e*) from the central region of the spore. Germ tube *a* has developed into a conidiophore on which a nearly mature conidium has formed. $\times 350$.

me that their material of the fungus agreed with my figures (Text-fig. 17).

From the records of the fungus it is clear that it is widespread, and further work will, I think, show that it is a very common aquatic species.

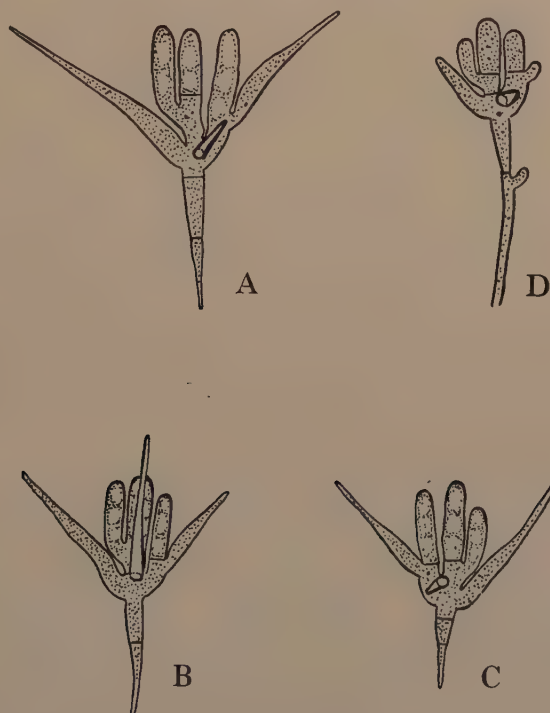
Tetracladium Marchalianum De Wild.

Submerged aquatic fungus with branched, septate mycelium. Conidiophore sparingly branched often with two conidia at different stages of development. Conidium (aleuriospore) normally consisting

of four divergent branches $20-40\mu$ long, $2-3\mu$ broad and of *two* more or less spherical knobs, $3-5\mu$ broad, one situated just above the point from which the four branches diverge, the other a short distance from this point on the upper side of one of the branches.

TETRACLADIUM SETIGERUM (Grove) n.comb.

During summer and autumn another and quite distinct species of *Tetracladium* (Text-fig. 22 and Pl. XIII, figs. 1, 2) was seen on the



Text-fig. 22. *Tetracladium setigerum* (Grove) n.comb. A, B, C, mature spores; D, conidiophore with a single developing spore. From alder leaves. $\times 730$.

decaying submerged alder leaves on about a dozen occasions. Throughout the summer of 1940 spores of this species were quite common in the stream water. I have not yet grown the fungus in pure culture.

The spores of this species differ from those of *T. Marchalianum* in certain constant features, namely: (i) there are three parallel finger-like processes, in addition to the four divergent arms, in place of the two knob-like protuberances of the spore of *T. Marchalianum*; (ii) the

arms of the spore are commonly shorter and taper more abruptly, this latter feature being especially evident in the first-formed arm of the spore. In spite of the fact that the range of spore shape exhibited by *T. Marchalianum* in pure culture is great, spores like those of the present species have never been observed.

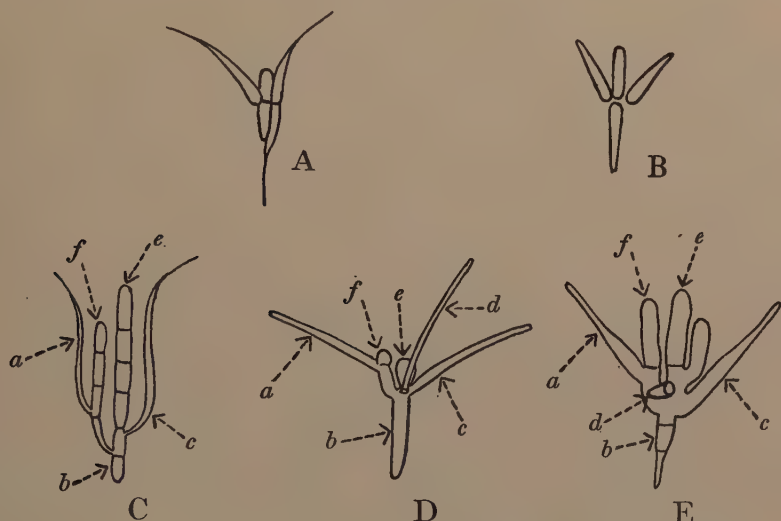
De Wildeman included figures of spores corresponding to those of the present species in his first (1893) and second (1894) descriptions of *T. Marchalianum*. Again, the structures figured by Reinsch (1888) as var. *incrassata* of his plankton alga *Cerasterias raphidioides* were probably spores of the present species, and this is certainly so with the material described by Huber-Pestalozzi (1925) as *Asterothrix (Cerasterias) raphidioides* (Reinsch) Printz. Grove (1912) described unmistakable conidia of this fungus under the binomial *Tridentaria setigera* Grove. He regarded the single condium as the whole fungus and thought that each of the three finger-like processes was itself a spore. Karling (1935) gave an account of *Tetracladium Marchalianum* based on material which probably belonged to the present species, although his conidia showed a considerable range of form which I have not observed in my material. However, the three finger-like processes and the abruptly constricted tip of the first-formed arm in the mature spore show complete agreement with my organism. If not identical with the present species, Karling's fungus is clearly much closer to it than to *T. Marchalianum* as I have limited it above. From the leaf carpet of woods Scourfield (1940) has noted the occurrence of conidia which he refers tentatively to *T. Marchalianum*. The conidium which he figures clearly belongs to the present species and has the three characteristic finger-like processes.

Since Grove was the first to give a name to this fungus as a separate species, his specific epithet stands, although the species must be removed from the genus *Tridentaria*. The name consequently becomes *Tetracladium setigerum* (Grove) n.comb.

In *T. setigerum* the general construction of the conidiophore agrees with that of *T. Marchalianum* and the spore is an aleuriospore. The first spore develops terminally and then the conidiophore branches a short way below its attachment to this spore to give a new hypha from which the second spore primordium is cut off. Observations on conidia, at different stages of development, and still attached to their conidiophores, make it clear that the course of development of the conidium is as it is in *T. Marchalianum* with only minor differences. The first knob at the end of the first-formed arm continues growth, becomes finger-like, and from near its base a branch grows up as another finger-like process parallel with the first. Further, the structure corresponding to the second knob of the spore in *T. Marchalianum* also becomes finger-like, so that, in the mature spore, there are the three parallel processes in addition to the four divergent arms.

Tetracladium setigerum (Grove) n.comb.

Aquatic fungus with branched, septate mycelium. Conidiophore sparingly branched. Conidium (aleuriospore) consisting of four divergent arms 20–40 μ long, each tapering from 3 μ near the central region of the spore to 1 μ near its tip, and of three elongated, parallel, finger-like processes, 12–15 μ long, 3–9 μ broad, two of which are inserted just above the point of divergence of the four arms and the third a short distance along one of the arms.



Text-fig. 23. A, *Titaea callispora* Sacc. Spore after Saccardo (from Lindau, 1906); B, *Titaea ornithomorpha* Trotter, spore after Trotter (1904); C, *Titaea maxilliformis* Rostrup (1894); D, *Tetracladium Marchalianum* De Wild., spore; E, *Tetracladium setigerum* (Grove) n.comb., spore.

NOTE ON *TITAEA* AND *TETRACLADIUM*

The genus *Titaea* was erected by Saccardo (1876) with the species *T. callispora* as the type. Since then four other species have been referred to this genus, namely, *T. rotula* v. Höhn., *T. ornithomorpha* Trotter, *T. maxilliformis* Rostr. and *T. Clarkei* Ell. & Everh. Most of these species are very briefly described. The descriptions by Saccardo (1876) of *T. callispora*, by Trotter (1904) of *T. ornithomorpha*, and by Rostrup (1894) of *T. maxilliformis*, are accompanied by figures of the spores, and these are reproduced in Text-fig. 23. The accounts of the other two species are unillustrated. Von Höhnelt (1904) describes the spore of *T. rotula* as follows: 'Sporulis ex articulis 4 constantibus; articulis singulis curvatis, 2–3 μ crassis, 20–40 μ lg., continuis vel

uniseptatis, in polo centrali crassioribus, rotundatis, cum hoc fere ut in rotulam connexis, in polo exteriori sensim attenuatis et in caudam filiformem, plus minus elongatam, plerumque unilateraliter curvatam productis.' Ellis and Everhart (1891) give the following description of the spore of *T. Clarkei*: 'Conidium of two vertical cells, upper one globose $7-9\mu$ dia., lower subovate and smaller but bearing on each of the two opposite sides a slightly curved or nearly straight spreading arm $40-45\mu$ long with two constrictions near the base where it is about 4μ thick and gradually attenuated above to a slender bristle-like tip.'

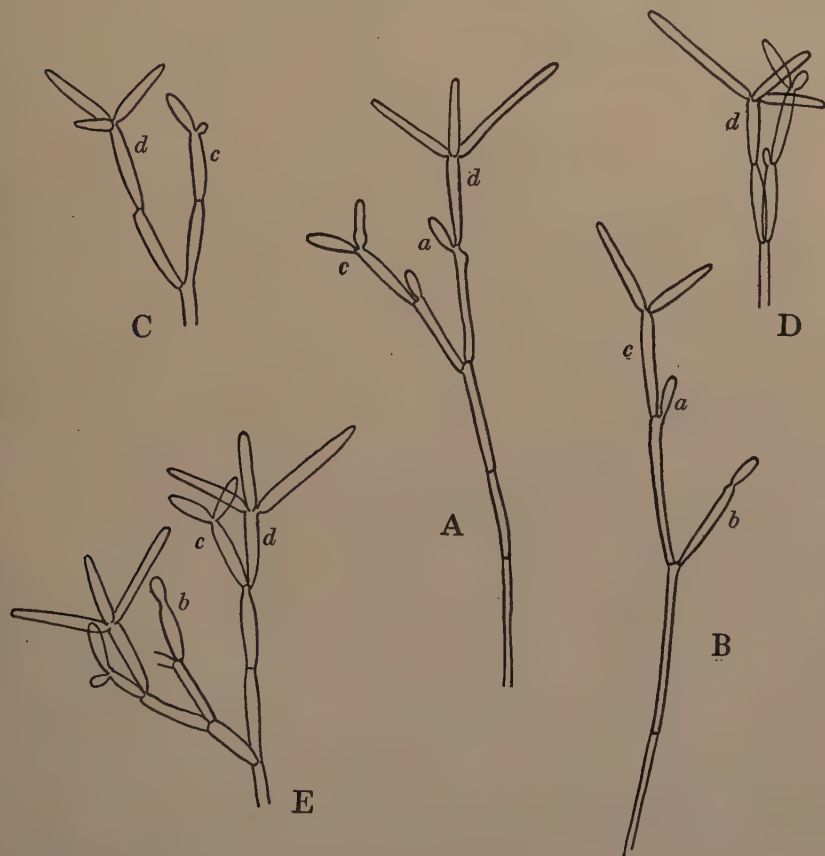
A comparison of the shapes of the spore in the five species does not seem to suggest that these organisms fall naturally into a single genus, and, if these fungi are rediscovered and investigated further, the genus may well have to be split. Von Höhnelt (1914), in reviewing the genus *Titaea*, considered that *T. maxilliformis* differed sufficiently from the other four species to be removed from *Titaea*. For this species he proposed a new genus and renamed the fungus *Maxillospora maxilliformis* (Rostr.) v. Höhn. In separating this species from the other species of *Titaea*, von Höhnelt seems to have been fully justified. A comparison of Rostrup's figures of *T. maxillospora* with spores of *Tetracladium Marchalianum* (as limited above) and with those of *T. setigerum* shows clearly that the same general plan of construction exists in all three species. This is brought out in Text-fig. 23 where the same letters are given to corresponding parts of the spore in the three species. Each part of the spore in *Titaea maxilliformis* corresponds to a part of the spore of *Tetracladium Marchalianum*, except that in the latter an extra arm 'd' is present. It seems quite clear that Rostrup's fungus belongs to *Tetracladium* and its name should, therefore, become ***Tetracladium maxilliformis*** (Rostr.) n.comb.

ARTICULOSPORA TETRACLADIA n.gen., n.sp.

This species (Text-figs. 24-26 and Pl. XIII, figs. 4, 5) was found fairly frequently on decaying submerged alder leaves throughout the year, and it has been isolated in pure culture on several occasions. The colony on malt agar is white, compact, and has a fair amount of white cottony superficial mycelium (Pl. XVI, fig. 8). No spores are produced either on malt agar or on oatmeal agar. Conidiophores are produced in abundance after twenty-four to thirty-six hours when a small slice of colony is immersed in water. Conidiophores and spores are produced only below the water surface, and these agree exactly with those formed in nature on the alder leaves.

The conidiophore is either simple or sparingly branched. In the development (Text-fig. 26) of a simple unbranched conidiophore an end-cell is cut off by a cross-wall. This is the spore-initial which is also

the first-formed arm of the spore. From the end of this cell there arises, rather like a bud from a yeast cell, the second arm of the spore which is separated by a narrow isthmus from the first arm. To begin with, this second arm is in line with the first, then, close to the point of origin of the second arm, but slightly to one side, the third arm

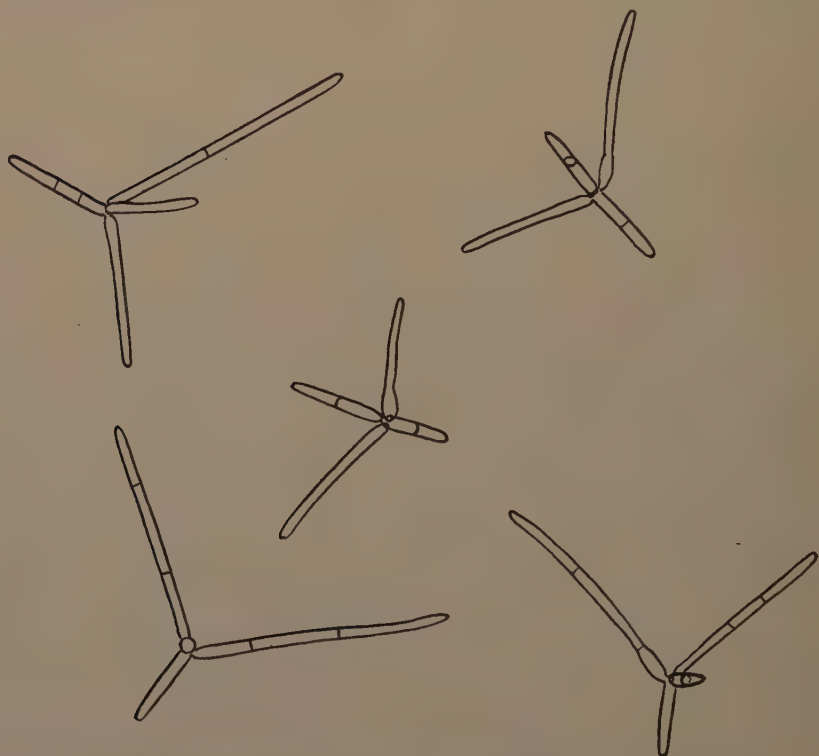


Text-fig. 24. *Articulospora tetracladia* n.gen., n.sp. Conidiophores with conidia at various stages of development. A and B, from pure culture; C, D and E, from alder leaves. *a*, developing spores at one-armed stage; *b*, developing spores at two-armed stage; *c*, developing spores at three-armed stage; *d*, nearly mature spores with four divergent arms. $\times 466$.

buds out from near the apex of the first arm displacing the second arm to one side so that the developing spore is now Y-shaped. Then, while the growth of the second and third arms still continues, the fourth arm buds out from near the apex of the first arm. The second, third and fourth arms of the spore are all separated from the first by an

isthmus, and the mature spore has four divergent branches which have arisen in succession.

Before the development of the first spore is complete a new spore-initial develops from the tip of the conidiophore immediately to one side of the first spore. This is soon delimited by a cross-wall at its base and its subsequent development is the same as that of the first spore. Meanwhile the first spore matures and is shed in the same way as the spore of *Clavariopsis* or *Tetracladium*. As the second spore reaches

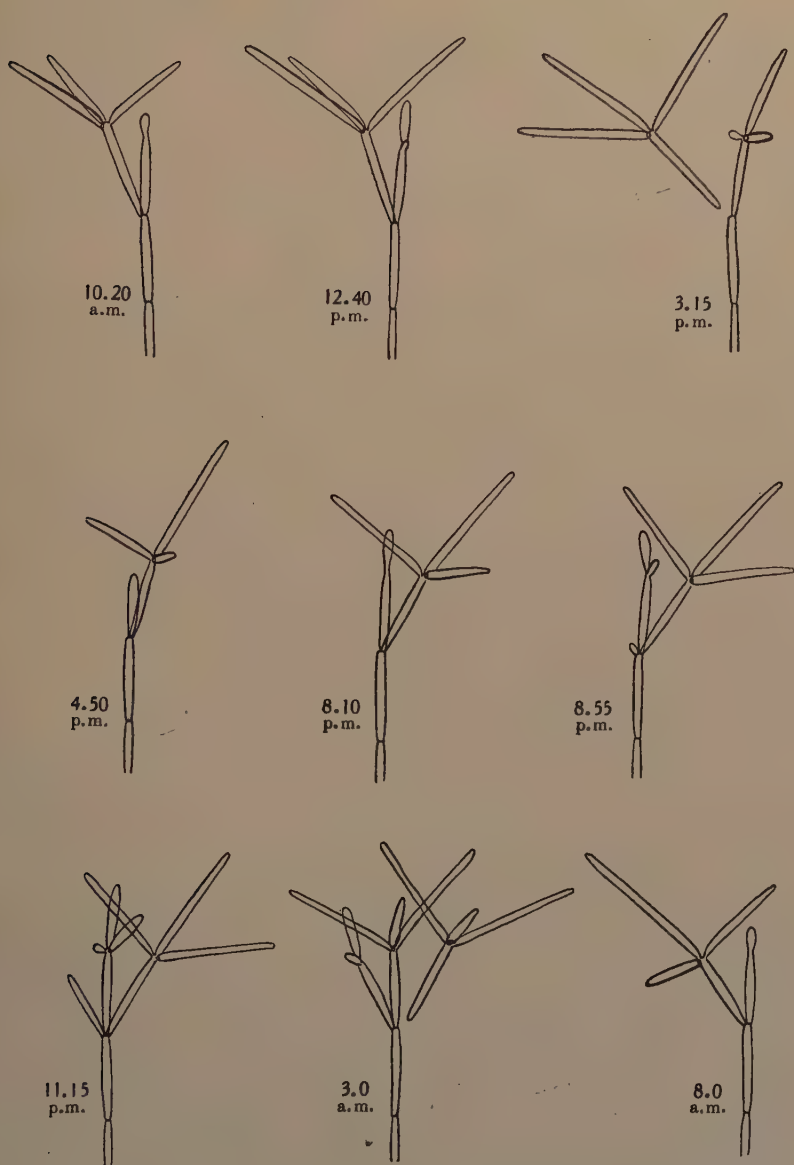


Text-fig. 25. *Articulospora tetracladia*. Spores from pure culture. $\times 466$.

maturity, a third spore-initial buds out from the conidiophore apex so that from a single simple conidiophore a number of spores may be produced. At one time there may be three spores at the end of the conidiophore, but these are all at different stages of development (Text-fig. 26, 11.15 p.m. and Pl. XIII, fig. 4).

It is clear that the spores are aleuriospores, each being separated at an early age from the conidiophore by a cross-wall. Where the conidiophores are branched, each branch behaves like a simple conidiophore.

The spores germinate readily in water or in 2% malt solution.



Text-fig. 26. *Articulospora tetracladia*. Conidiophore drawn at intervals during a period of twenty-two hours. From hanging-drop pure culture. $\times 540$.

This fungus seems to be more nearly related to *Tetracladium* than to any other genus. The development of the four arms of the spore in succession is a strong point of similarity. However, the bulges in addition to the four arms, so characteristic of *T. Marchalianum*, *T. setigerum*, and *T. maxilliformis*, are absent, and it would be straining the limits of that genus to include the present species. A new genus is therefore proposed. The generic name *Articulospora* is suggested by the 'jointed' nature of the spore due to the isthmus where each of the later-formed arms of the spore joins the first-formed arm.

***Articulospora* n.gen.**

Aquatic fungi with branched, septate mycelium. Conidiophores and conidia (aleuriospores) produced below water. Conidium of four long divergent arms which develop in succession. There is a constriction where each of the three later-formed arms joins the first-formed arm of the spore.

***Articulospora tetracladia* n.sp.**

Submerged aquatic fungus with branched, septate, hyaline mycelium. Conidium (aleuriospore) hyaline, of four divergent arms; the first-formed arm 20–35 μ long, 3 μ broad, 1–2 septate; the other three arms 36–75 μ long, 3 μ broad, 1–3 septate, each with a narrow constriction or isthmus where it joins the short arm. In the formation of the spore the four arms arise in succession. Conidiophore simple or branched, producing spores from its apex (or apices) in succession, not basipetal but side by side.

On decaying leaves of *Alnus glutinosa* from a stream in Leicestershire, England.

***Articulospora* gen.nov.**

[Lat. *articulus*, a joint, from the jointed structure of the spore.]

Fungi aquatici, mycelio repente, hyalino, septato, ramoso. Conidiophora conidiaque submersa. Conidia (aleuriosporae) hyalina, septata, quadriradiata, prope eundem locum deinceps evoluta; radii ex ordine evoluti, radio primario cylindrico, ceteris basi constricti.

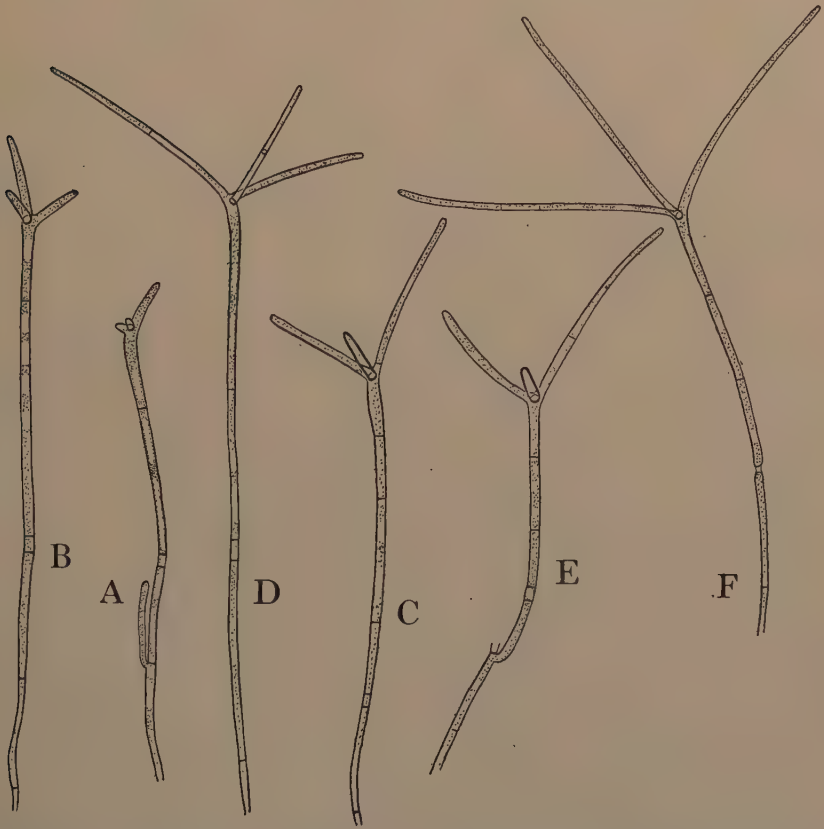
***Articulospora tetracladia* sp.nov.**

Fungus omnino submersus, mycelio repente, hyalino, septato, ramoso. Conidiophora hyalina simplicia vel ramosa, filiformia, erecta, apice sporogena. Conidia (aleuriosporae) hyalina, quadriradiata, compluria prope eundem locum deinceps evoluta; radii cylindrici, radius primarius 20–35 $\times$ 3 μ , 1–2 septatus, radii ceteri postea evoluti, longiores, 35–75 $\times$ 3 μ , 1–3 septati, basi constricti.

Hab. In foliis putrescentibus *Alni glutinosae* in flumine jacentibus, Leicestershire, Anglia.

TETRACHAETUM ELEGANS n.gen., n.sp.

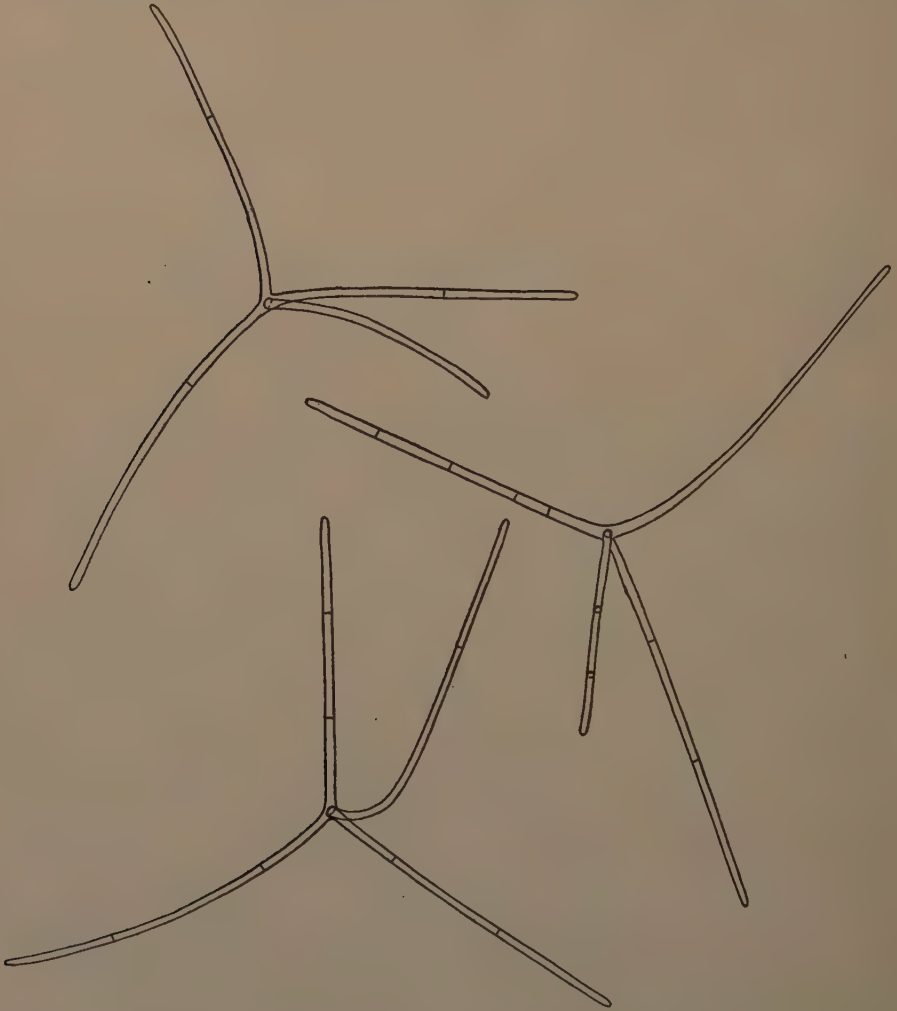
This remarkable fungus (Text-figs. 27-29 and Pl. XV, figs. 1-3) was observed on decaying submerged leaves of alder throughout the year and was also occasionally seen on decaying willow leaves. It was



Text-fig. 27. *Tetrachaetum elegans* n.gen., n.sp. Conidiophores at various stages of development. In each the separating cell can be seen. In E the remains of the first separating cell can be seen at the tip of the conidiophore, but a branch below this has developed and bears a terminal conidium. In F the separating cell is on the point of breaking down. $\times 315$.

especially abundant during the autumn and early winter. The mycelium lies chiefly in the main veins and petioles of the leaves, and the conidiophores grow out at right angles into the water. The conidiophore is nearly always simple and bears a single terminal spore.

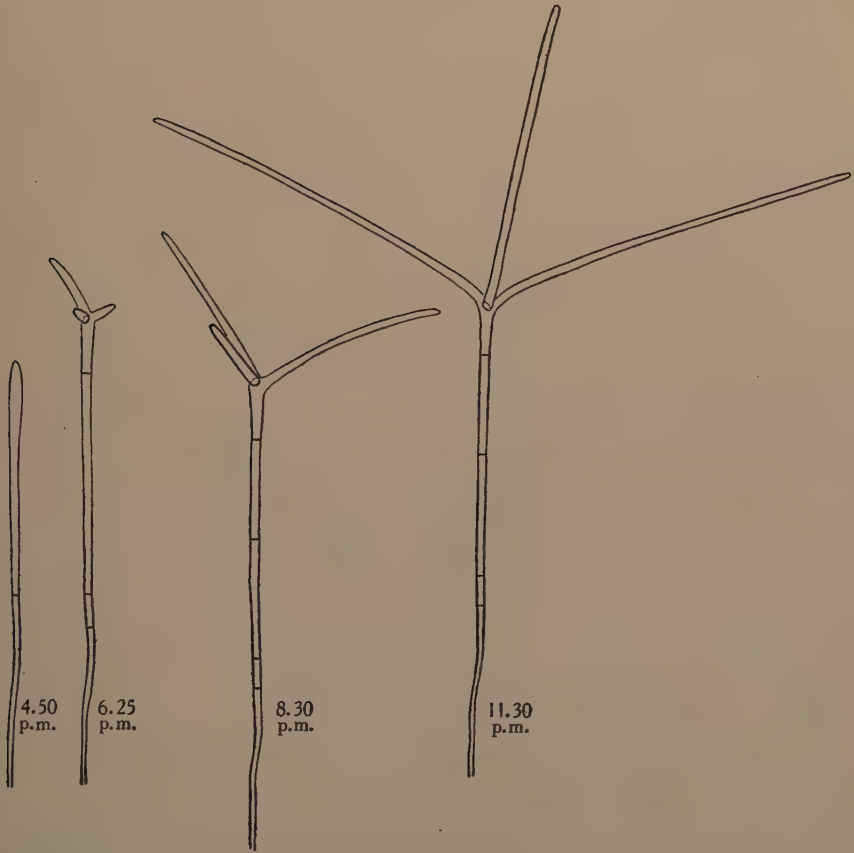
The fungus has been isolated in pure culture. On malt agar a compact colony of branched septate hyphae is produced (Pl. XVI, fig. 2). This is whitish and there is much white, fleecy, aerial growth. Both on malt agar and on oatmeal agar, spore formation fails to occur,



Text-fig. 28. *Tetrachaetum elegans*. Spores from pure culture. $\times 350$.

but when a slice of the colony is submerged in water spore production occurs within twenty-four hours. The conidiophores and spores formed under these conditions agree exactly with those produced on the alder leaves in nature.

The conidiophore is, at first, a straight hypha (Text-fig. 29) which soon becomes narrowly club-shaped. The terminal part of this is cut off by a wall forming a long cell which is the spore primordium. Shortly afterwards another cross-wall delimits a short 'separating cell' immediately below the spore primordium. As the apical growth



Text-fig. 29. *Tetrachaetum elegans*. Spore development. At 4.50 p.m. the separating cell was not yet formed, but by 6.25 p.m. it was delimited at the end of the conidiophore. The spore was shed some time between 11.30 p.m. and 1 a.m. By 11.30 p.m. the separating cell had lost most of its protoplasmic contents and the spore did not grow any further. From pure culture hanging-drop. $\times 432$.

of the spore primordium continues, a curvature arises and growth proceeds in a direction forming an obtuse angle with the first-formed part of the spore primordium. On the convex side of the angle thus formed two lateral growing points arise side by side and at the same level. The young spore has now three growing points, and each of

these grows until the four-armed spore is produced in which the arms are finally all of much the same length. The mature spore (Text-fig. 28 and Pl. XV, fig. 3) thus consists essentially of a main axis (bent to an obtuse angle half way along its length) and two lateral branches. The spore is remarkably large with a span of over 200μ , the individual arms being about 120μ long and 2.5μ broad. Each arm is normally divided into two or three cells. The spores are extremely like the largest spores of *Lemonniera aquatica*. Indeed, in the mixed cultures which occur in nature on the alder leaves and in which both fungi habitually occur, it is not always possible, when examining liberated spores, to be sure whether a particular one is an especially large spore of *L. aquatica* or a rather small spore of *Tetrachaetum elegans*. The chief consistent difference is that in the latter the arms of the spore are thinner and longer.

The manner of liberation of the spore, which is clearly an aleurio-spore, is somewhat unusual. The end-cell of the conidiophore is a separating cell (Text-figs. 27, 29 and Pl. XV, figs. 1, 2), which, when the spore is ripe, loses its contents and ruptures along a transverse line of weakness. When the spore has separated, all that is left of the 'separating cell' is a little collar of cell wall at the end of the conidiophore and a similar but shorter collar on the end of the spore. These collars can, however, be seen only for a short time after spore liberation; they soon disappear. Following the loss of its terminal spore, the conidiophore may branch again below the old separating cell, and a new spore, with a separating cell below it, is formed. This branching was observed only under conditions of culture. I have seen no branched conidiophores on the alder leaves, although thousands have been examined. The manner of spore liberation shows a very close agreement with that reported by Dowding and Orr (1939) for the aleuriospores of the dermatophyte *Microsporum lanosum*.

The spores of *Tetrachaetum elegans* germinate readily in water, a fine germ tube usually being produced from each of the four tips of the spore.

***Tetrachaetum* n.gen.**

Submerged aquatic fungi with branched, septate mycelium. Conidium terminal consisting of four long branches diverging from a common point, with one branch of the spore, before liberation, continuous with the conidiophore. Short separating cell at the end of the conidiophore. Spore liberated by the breakdown of this separating cell.

***Tetrachaetum elegans* n.sp.**

Aquatic fungus with branched, septate, hyaline mycelium. Conidiophores and conidia (aleuriospores) formed under water. Conidiophore usually simple, with a single terminal aleuriospore consisting

of four, nearly equal, divergent branches each $120-150\mu$ long, $2-4\mu$ broad, 1-4 septate. When attached to its conidiophore one arm of the spore is continuous with the conidiophore and of much the same width. Short separating cell $5-8\mu$ long, 3μ broad at end of conidiophore. Aleuriospore liberated by the breakdown of this cell.

On decaying leaves of *Alnus glutinosa* and *Salix* sp. from a stream in Leicestershire, England.

Tetrachaetum gen.nov.

[Gr. τετρα, four, and χ αίτη, a hair, from the four hair-like arms of the spore.]

Fungi aquatici, submersi, mycelio repente, septato, ramoso. Conidiophora hyalina erecta, filiformia. Conidia (aleuriosporae) acrogena, hyalina, septata, quadriradiata, radio primario cum conidiophoro continuo. Inter conidium et conidiophorum cellula brevis adest, quae conidii maturitate disjungitur.

Tetrachaetum elegans sp.nov.

Fungus aquaticus, mycelio hyalino repente, septato, ramoso. Conidiophora conidiaque omnino submersa, conidiophora hyalina, plerumque simplicia, unam modo aleuriosporam acrogenam gerentia. Conidia (aleuriosporae) hyalina, quadriradiata, radiis subaequilongis, $120-150\mu$ longis, $2-4\mu$ latis, 1-4 septatis; radius primarius cum conidiophoro continuus et per cellulam brevem $5-8\mu$ longam, 3μ latam ab illo diversus. Conidii maturitate cellula separans disjungitur.

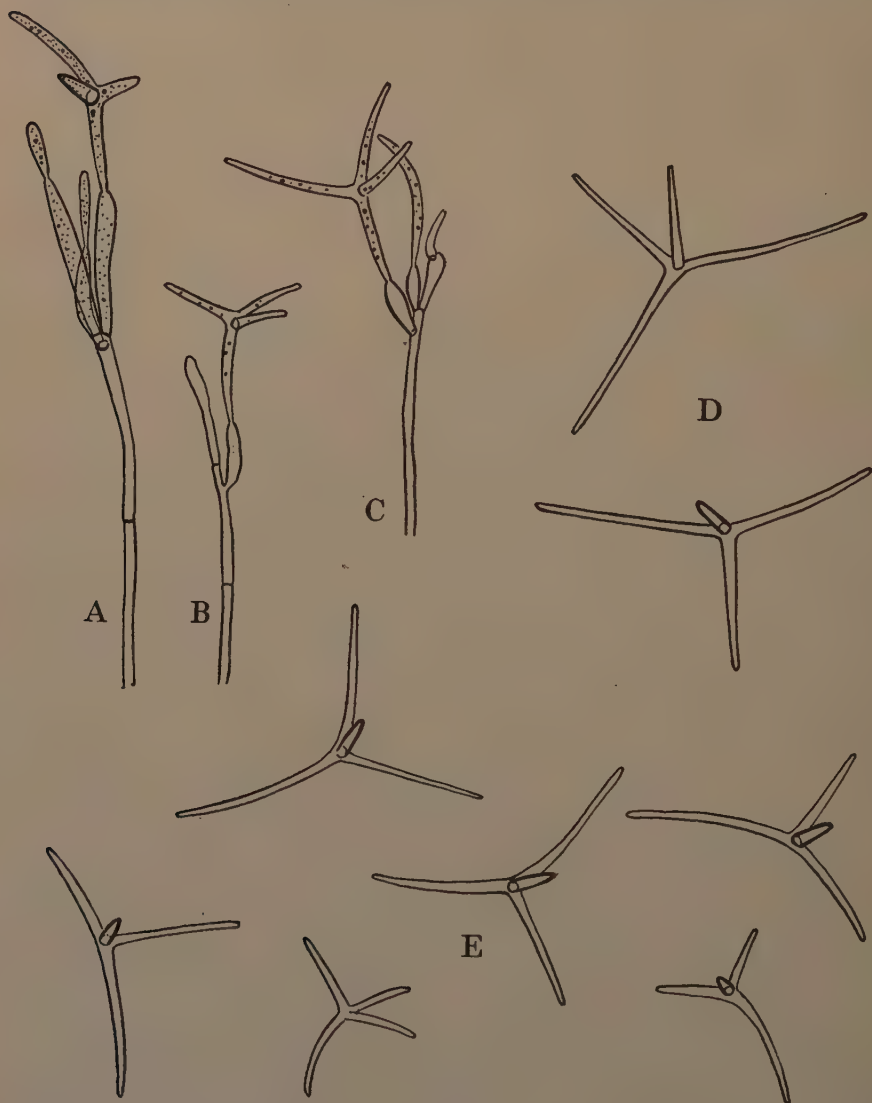
Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

ALATOSPORA ACUMINATA n.gen., n.sp.

This fungus (Text-figs. 30, 31 and Pl. XIV, fig. 5) was found throughout the year on decaying submerged leaves of alder and willow. It was especially common during winter and spring, but much less frequent during summer and autumn. It has been isolated in pure culture.

On malt agar a compact whitish colony is produced of fine septate hyphae. The leading hyphae of the growing margin of the colony are only 2.5μ broad. There is very little aerial growth, and this is sometimes absent altogether. Spores failed to form on the colony on malt agar or on oatmeal agar, but, shortly after the isolation of the fungus, it sporulated when strips of colony were submerged in water. The production of conidia under these circumstances was very poor compared with that of the other alder-leaf fungi which have been grown in pure culture, but the conidia produced agreed exactly with those

found on the alder leaves. After the fungus had been in culture for a month or so, it failed to form spores even when strips of the colony



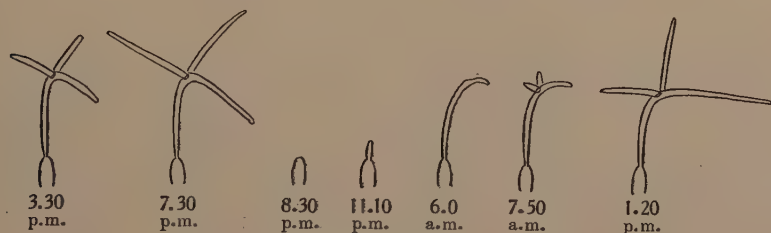
Text-fig. 30. *Alatospora acuminata* n.gen., n.sp. A, B, C, conidiophores; D, two spores from pure culture; E, spores from alder leaves. A, $\times 1090$; B, C, D and E, $\times 720$.

were immersed in water. This behaviour was in sharp contrast with that of the other alder-leaf fungi in which cultivation on malt agar

for six months to a year did not seem to impair their ability to sporulate when transferred to water.

In nature the conidiophores jut out at right angles from the veins and petioles of the decaying alder leaves. The conidiophore is usually simple, consisting of a single phialide, but it may be branched with two or three phialides.

The form of the conidium and the manner of development of the arms of the spore show a great similarity to *Tetrachaetum elegans*. However, in that fungus the spore is an aleuriospore, while in the present species it is a phialospore. In development there grows out from the apex of the phialide a straight hypha which, when it has reached a length of about 25μ , undergoes a more or less abrupt



Text-fig. 31. *Alatospora acuminata*. Spore development from a single phialide only the upper part of which is visible; the lower part is hidden in the tissues of the decaying alder leaf. The first spore was shed between 7.30 p.m. and 8.30 p.m.; the second spore was shed between 2 p.m. and 3 p.m. $\times 550$.

curvature. On the convex side of this curve, and a short distance behind the growing apex of the spore primordium, two new growing points arise side by side and at the same level. The three growing points of the young spore now develop until the mature spore is formed with its four divergent arms. As in *Tetrachaetum* the spore thus consists of two laterals branching out side by side from a main axis which is bent at the point where the laterals originate. The spores of the present species are very much smaller than those of *Tetrachaetum*; further, each arm tapers to a fairly acute point and septa are absent.

The spores germinate readily in water, the fine germ tubes developing usually from the tips of the arms.

In its form the spore of this fungus bears a striking resemblance to Perty's (1852) alga *Phycastrum longispinum* (*Tetraedron longispinum* (Perty) Hansgirg), and it is possible that just as spores of *Tetracladium* spp. were mistaken by certain workers (e.g. Reinsch (1888) and Huber-Pestalozzi (1925)) for plankton algae, so *Phycastrum longispinum* may have been founded on fungal conidia. However, Perty's organism may well have been a genuine alga as he figures it as bright green.

Since the spore is a phialospore and not an aleuriospore, it is undesirable to include the present fungus in the genus *Tetrachaetum*; it is therefore placed in a new genus.

The generic name *Alatospora* is suggested by the resemblance of the spore to a bird in flight.

✓ ***Alatospora* n.gen.**

Submerged aquatic fungi with branched, septate mycelium. Conidium (phialospore) consisting of four arms diverging from a common point. The development indicates that the spore consists of a curved main axis (forming two of the arms) and two laterals inserted at about the middle point of this axis.

✓ ***Alatospora acuminata* n.sp.**

Submerged aquatic fungus with branched, septate mycelium. Conidiophore usually unbranched consisting of a single phialide 10–20 μ long, 2–3 μ broad, but often branched producing a group of two to four phialides. Conidium (phialospore) unicellular, hyaline, consisting of four divergent and approximately equal arms, 15–35 μ long, 1.5–2.5 μ broad, tapering towards their apices. Conidia produced in basipetal succession from the phialide.

On decaying leaves of *Alnus glutinosa* and *Salix* sp. from a stream in Leicestershire, England.

Alatospora gen.nov.

[Lat. *alatus*, winged, from the resemblance of the spores to a bird in flight.]

Fungi aquatici submersi, mycelio repente, septato, ramoso. Conidiophora hyalina, filiformia, erecta, septata, plerumque simplicia, subinde apice ramosa phialides gerentia. Conidia (phialosporae) hyalina, continua quadriradiata, e radio principali in media parte radiolos binos oppositos gerente composita.

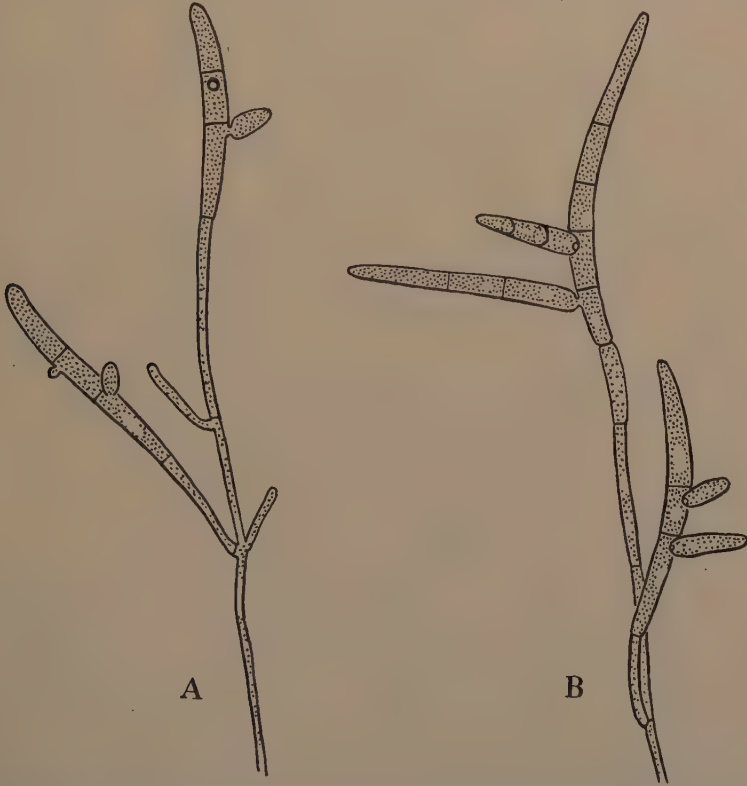
Alatospora acuminata sp.nov.

Fungus aquaticus submersus, mycelio hyalino repente, septato, ramoso. Conidiophora hyalina plerumque simplicia, phialide singula 10–20 μ longa, 2–3 μ lata efferenda, sed aliquando ramosa, 2–4 phialides gerentia. Conidia (phialosporae) ex eadem phialide deinceps evoluta, continua, hyalina, quadriradiata, radiis 15–35 μ longis, 1.5–2.5 μ latis, apice attenuatis. Ramus principalis curvulus primo ortus est, deinde e media parte bini ramuli secundarii oppositi exoriuntur.

Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

TRICLADIUM SPLENDENS n.gen., n.sp.

This fungus (Text-figs. 32-35, Pl. XIII, figs. 8, 9) is a fairly frequent but rarely abundant member of the fungous flora of decaying submerged alder leaves throughout the year. In nature the conidiophores project into the water from the petioles and main veins. In culture on malt agar a compact colony of branched septate hyphae is

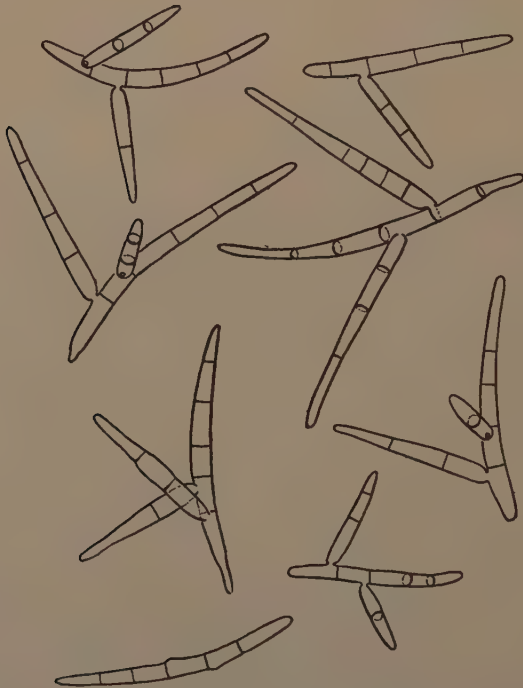


Text-fig. 32. *Tricladium splendens* n.gen., n.sp. Branched conidiophores from pure culture. A, the two developing conidia are just forming their lateral branches. B, in this conidiophore the spores are older, the upper one being nearly ripe and beginning to separate from the conidiophore. $\times 466$.

produced (Pl. XVI, fig. 1). This is very dark olive-green with a narrow white fringe. In the dark central region there is considerable aerial growth of dark olive-green mycelium. On malt agar and on oatmeal agar spore formation fails to occur, but when a strip of the colony is transferred to water, conidia are produced in about twenty-four hours. The conidiophores develop from the inflated dark cells

of the old mycelium, but, as in all these submerged alder-leaf fungi, the conidiophores and spores are colourless. The spores formed under these artificial conditions agree exactly with those produced in nature.

At an early stage in development the spore primordium is a club-like swelling at the end of a thin straight conidiophore from which it is cut off by a cross-wall (Text-fig. 34). As this primordium elongates, it becomes septate and slightly curved, and from it there develop two lateral branches of which the lower one begins to grow out before the



Text-fig. 33. *Tricladium splendens*. Spores from pure culture. $\times 350$.

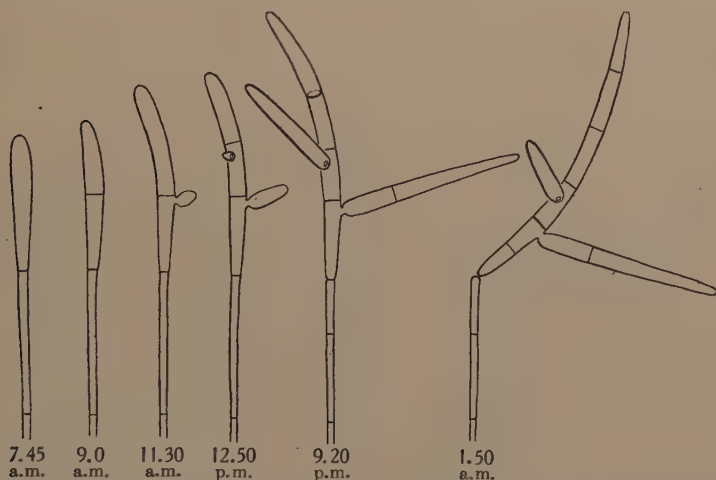
upper. These two branches are never in the same plane, but they develop typically, on the convex side of the curved main axis of the spore. At the widest parts of the main axis and of the laterals the diameter is $6-7\mu$, but both the axis and the branches taper to $2-3\mu$ at the apices. At the point of attachment of each lateral is a characteristic constriction. When the spore is mature both the main axis and its two laterals are septate.

The conidiophores on the submerged alder leaves are nearly always simple, but when developed from a slice of colony submerged in water they are sometimes, though not often, branched (Text-fig. 32).

This difference is probably associated with differences in the food supply under the two sets of conditions. The most usual type of conidiophore is that shown in Text-fig. 34 and in Pl. XIII, fig. 8.

The spore is clearly an aleuriospore, and when mature it separates from the conidiophore by disjunction at the cross-wall which separates it from the conidiophore just as in *Clavariopsis* and in *Tetracadium*.

The spores are very beautiful with a pearly appearance due to the presence of abundant glycogen. Although the lengths of the main axis and of its arms vary considerably, the width of these structures remains very constant. Under conditions of culture spores with only one lateral branch are very occasionally to be seen and once a spore



Text-fig. 34. *Tricladium splendens*. Spore development. From hanging-drop pure culture. $\times 440$.

without branches was observed. In nature only spores with a main axis and two laterals have been noticed.

The present species shows a certain resemblance to Drechsler's (1937) *Tridentaria carnivora* which preys on the rhizopod *Diffugia*. His fungus bears, on a simple conidiophore, a terminal spore consisting of a somewhat fusiform main axis with two laterals which, however, arise at the same level. Although my fungus shows a marked similarity with *Tridentaria carnivora* it bears no resemblance to *T. implicans* Drechsl., a parasite of nematodes, in which the spore consists of a short basal arm with a crown of three much longer divergent arms. Indeed, the structure of the spore in that fungus agrees more nearly with *Clavariopsis aquaticus*. In both *Tridentaria carnivora* and *T. implicans* the conidiophore is an aerial structure bearing an aerial spore,

and because of this important difference, and because of the great difference in the substrata, it seems unsafe to associate the present species with Drechsler's fungi. In consequence it has been decided to make this fungus the type of a new genus, *Tricladium*. The name is suggested by the structure of the spore which consists of three hyphae, namely a main axis and two laterals.



Text-fig. 35. *Tricladium splendens*. Germinating spore after twenty-four hours in 2% malt solution. $\times 280$.

***Tricladium* n.gen.**

Submerged aquatic fungi with branched, septate mycelium. Conidium (aleuriospore), septate, hyaline, consisting of an elongated main axis with two lateral branches arising at different levels from the main axis.

***Tricladium splendens* n.sp.**

Submerged aquatic fungus with branched, septate mycelium. Conidiophore usually simple. Conidium (aleuriospore) terminal, hyaline, consisting of a main axis, fusiform, 3-6 septate, 60-120 μ

long, $6-7\mu$ broad at widest part, and of two lateral branches $30-80\mu$ long, $6-7\mu$ broad at their widest part, tapering to $2-3\mu$ at their apices, with a narrow isthmus, 2μ wide, where each branch joins the main axis of the spore. The two branches originate from the main axis of the spore at levels $10-20\mu$ apart.

On submerged decaying leaves of *Alnus glutinosa* from a stream in Leicestershire, England.

Tricladium gen.nov.

[Gr. τρεῖς, three, κλάδος, a branch, from the three-branch nature of the spore.]

Fungi aquatici submersi, mycelio repente, septato, ramoso. Conidiophora erecta, filiformia. Conidia (aleuriosporae) multi-septata, hyalina, ramosa, ramulis duobus lateralibus e ramo primario separatim orientibus.

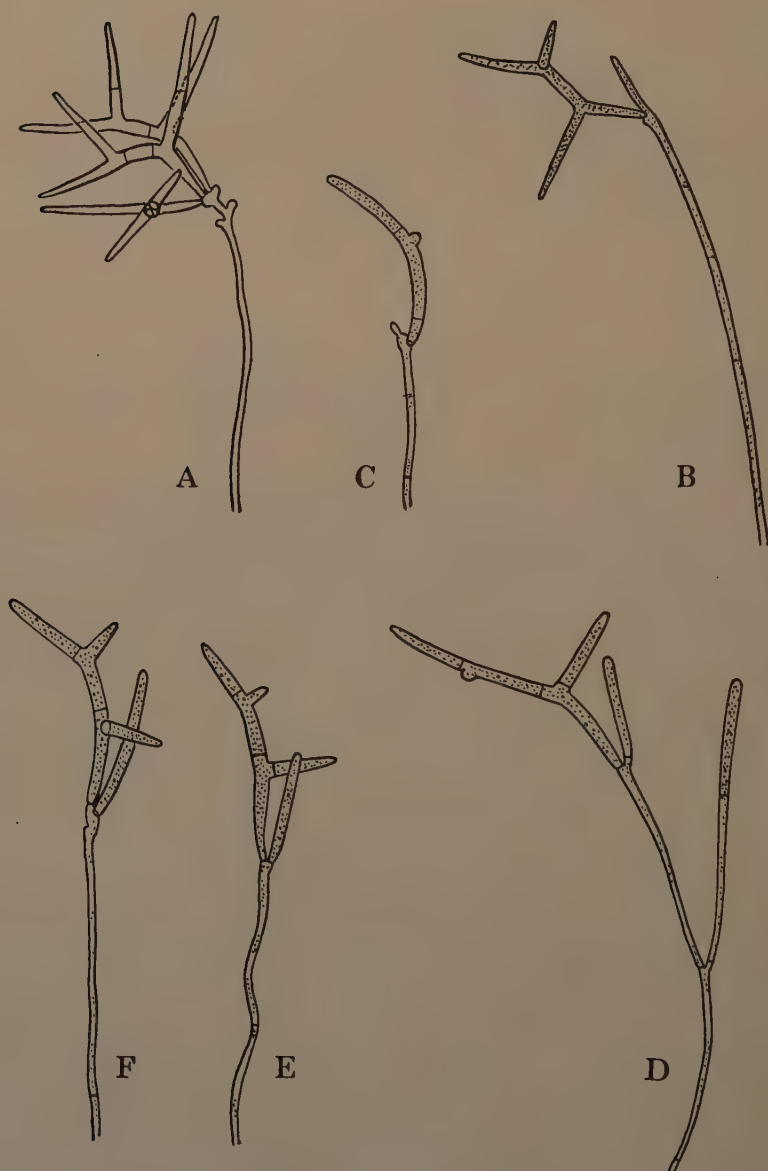
Tricladium splendens sp.nov. (Typus generis)

Fungus aquaticus submersus, mycelio repente, septato, ramoso, primo hyalino, demum olivaceo-fuscescente. Conidiophora hyalina, plerumque simplicia, erecta, filiformia. Conidia (aleuriosporae) acrogena, hyalina, ramosa; ramus principalis fusiformis, $60-120\mu$ longus, $6-7\mu$ latus, $3-6$ -septatus; ramuli secundarii duo, $30-80\mu$ longi, $6-7\mu$ lati, apicem versus ad $2-3\mu$ attenuati, basi ad 2 constricti, e locis $10-20$ separatis orientes.

Hab. In foliis putrescentibus *Alni glutinosae* in flumine jacentibus, Leicestershire, Anglia.

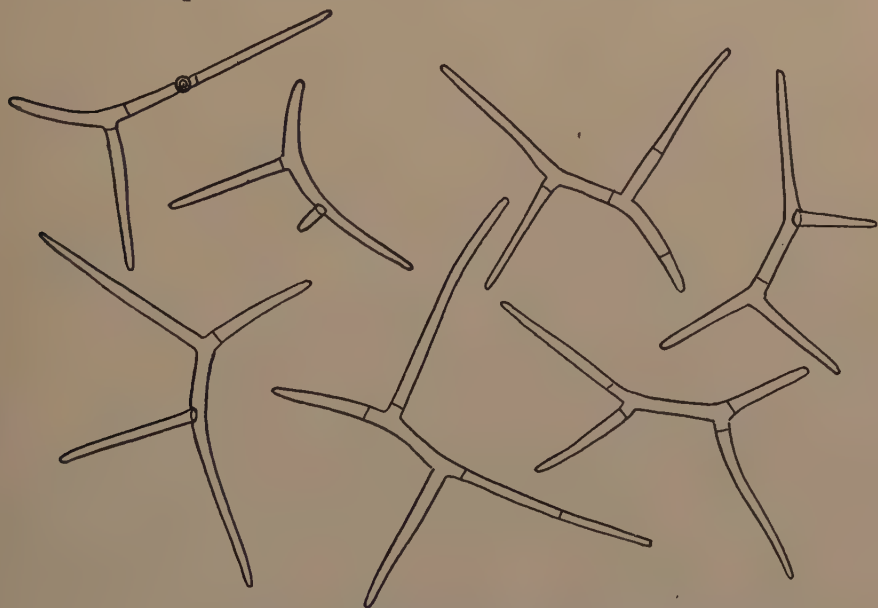
TRICLADIUM ANGULATUM n.sp.

The fungus (Text-figs. 36-38 and Pl. XIV, figs. 1, 2) was observed on scores of occasions throughout the year growing on submerged decaying alder leaves, but it was much more frequent during winter and spring than at other times. The conidiophores grow out at right angles from the tissues of the leaf especially from the petioles and larger veins. The conidiophores are submerged structures, and the spores are formed and liberated below water. The conidiophore is either simple or branched to a slight extent. It usually arises as a straight hypha, broadening somewhat towards its free end, which grows out into the water. At an early stage the end of this is cut off by a cross-wall, and this terminal cell represents the primordium of the first spore. As this cell elongates by its apical growth, it becomes somewhat curved and gives rise to two lateral branches, the lower one arising before the upper one (Text-fig. 38). These two branches are rarely in the same plane. Both lateral branches of the spore are broadly inserted on the main axis, and each tapers from its base, where it is 4μ wide, to its



Text-fig. 36. *Tricladium angulatum* n.sp. Conidiophores A and B, from alder leaves; C, D, E and F, from pure culture. In A three spores are shown; the bottom one is in end-on view. In C the first branch is just beginning to develop from the curved spore primordium. In D and E the developing spore on the left has produced its first lateral branch and the second one is just beginning to grow out. In F the left-hand spore is nearly mature. $\times 466$.

apex, where the width is reduced to 2μ . At the point of origin of each lateral the main axis of the spore is usually bent into the form of an obtuse angle. Thus the main axis of the spore does not form a smooth curve, as in *Tricladium splendens*, but is like a stick that has been fractured at two points along its length. On inspecting the mature spore of *T. splendens*, it is evident that it consists of a main axis with two laterals, but with *T. angulatum* this is not nearly so clear, and it is only when spore development is followed that it becomes apparent. Further, as in *T. splendens*, it is clear from development that the spore is an aleuriospore.

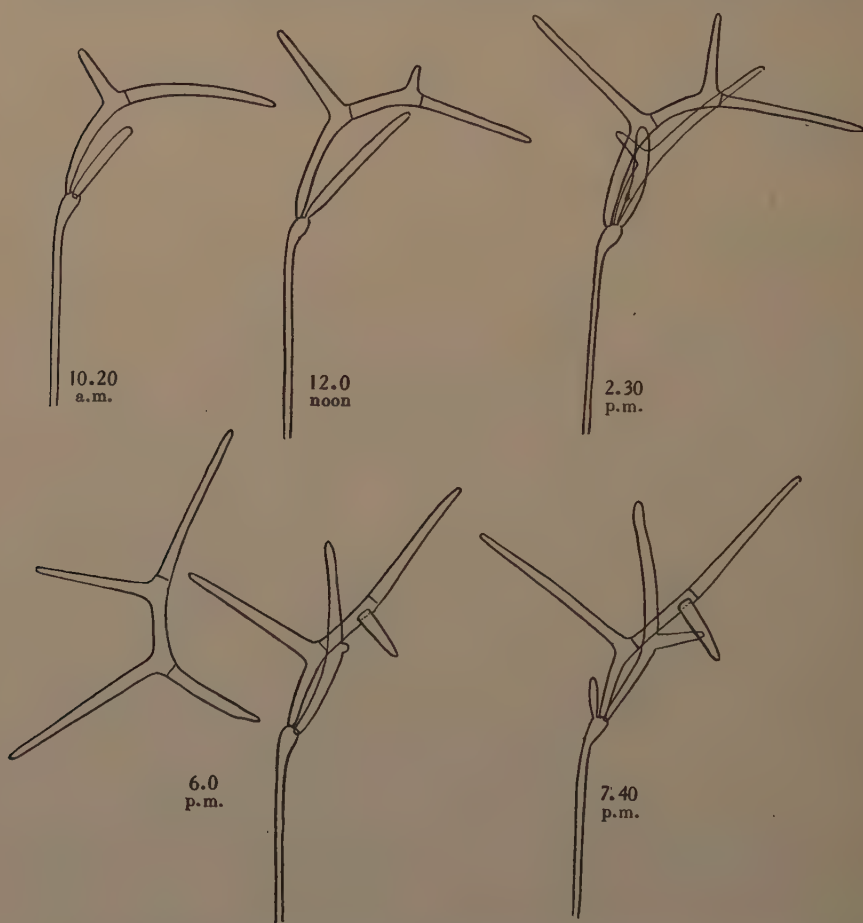


Text-fig. 37. *Tricladium angulatum*. Spores developed under conditions of pure culture. $\times 466$.

Usually before the first spore is fully formed, a new hypha grows out from the axis of the conidiophore immediately to one side of this spore. This may give rise to a branch terminated by a spore or, more frequently, the hypha is cut off at an early stage by a basal wall and is itself the primordium of a new spore (Text-fig. 38). In turn, as this matures another spore may develop beside it. In this way a number of spores may be produced from the single end of the conidiophore, and as this process proceeds the conidiophore apex gradually broadens. This successive production of a number of aleuriospores from the end of a conidiophore is very like what happens in *Articulospora tetracлада* and in *Lunulospora* (see p. 406), but it finds no parallel

in *Tricladium splendens*. As in other Hyphomycetes on alder leaves the spore is usually liberated as soon as it is mature. The manner of liberation agrees with that of *T. splendens*.

The fungus has been isolated in pure culture. It forms a compact colony of branched, septate hyphae on malt agar with the leading



Text-fig. 38. *Tricladium angulatum*. Conidiophore showing spore-development. From hanging-drop pure culture. $\times 550$.

hyphae of the growing margin 3μ wide. The hyphae remain colourless and there is a little white aerial growth. This white colony (Pl. XVII, fig. 1) is in striking contrast to the almost black colony with a narrow white margin of *T. splendens* on malt agar. In Saccardo's classification of the Hyphomycetes this colour distinction was made

the basis of the separation of the families Moniliaceae and Dematiaceae, but recent workers on the Hyphomycetes tend to reject this distinction as of little systematic importance. The colony on malt agar and on oatmeal agar fails to form spores, but when a strip is submerged in water, conidiophores and spores, exactly like those formed in nature, are produced in abundance within thirty-six hours.

It seems clear that this fungus should go into the same genus as *T. splendens*, since the general structure of the aleuriospore is the same in both. However, the two species are sharply distinguished not only by cultural characters but also by the details of spore structure. The essential features in which the spore of the present species differs from that of *T. splendens* are: (i) the width of the main axis at its widest part is 4μ as compared with $6-7\mu$ in *T. splendens*; (ii) the two lateral branches are not constricted at their insertion on the main axis of the spore; and (iii) this axis is not fusiform, as in *T. splendens*, but is usually bent forming an obtuse angle at the point of origin of each lateral.

✓
***Tricladium angulatum* n.sp.**

Submerged aquatic fungus with branched, septate mycelium. Conidiophore simple or sparingly branched. Conidium (aleuriospore) hyaline, septate, branched, consisting of a main axis $60-120\mu$ long, 4μ broad at the widest part, 1-4 septate, and of two lateral branches each $30-70\mu$ long, $3-4\mu$ broad at the base tapering to $1.5-2.0\mu$ at the apex, *not constricted* where each joins the main axis of the spore. Main axis of spore usually bent to an obtuse angle at the point of origin of each lateral. Distance between the points of origin of the two lateral branches $10-15\mu$.

On submerged decaying leaves of *Alnus glutinosa* from a stream in Leicestershire, England.

***Tricladium angulatum* sp.nov.**

Fungus aquaticus submersus, mycelio hyalino repente, septato, ramoso. Conidiophora hyalina, simplicia vel parce ramosa, erecta. Conidia (aleuriosporae) acrogena, hyalina, septata, ramosa; ramus principalis $60-120\mu$ longus, 4μ latus, 1-4 septatus; ramuli duo secundarii $30-70\mu$ longi, basi $3-4\mu$ lati, non constricti, apice ad $1.5-2.0\mu$ attenuati. Ramus principalis plerumque curvulus vel iisdem locis e quibus ramuli secundarii oriuntur obtuse angulatus; ramuli e locis $10-15\mu$ separatis orientes.

Hab. In foliis putrescentibus *Alni glutinosae* in flumine jacentibus, Leicestershire, Anglia.

VARICOSPORIUM ELODEAE Kegel

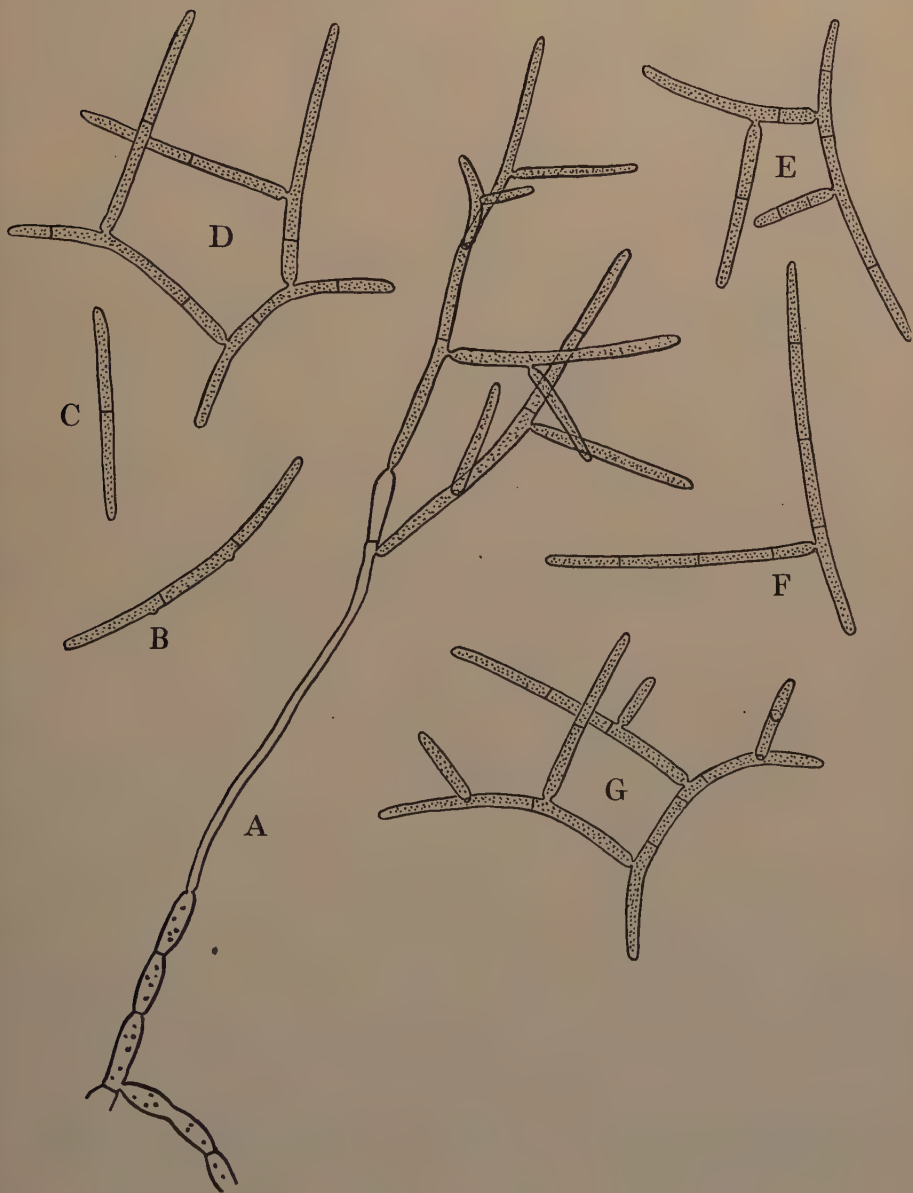
This fungus (Text-fig. 39 and Pl. XIV, figs. 3, 4) was found growing abundantly on the submerged decaying alder leaves during the winter and spring, but in the summer and autumn it was seldom seen.

The species was described originally by Kegel (1906) growing on dead *Elodea* which had been used in a physiological experiment. My fungus agrees so closely with Kegel's description that I have no doubt it is the same. He observed the conidiophores and gave excellent figures of the conidia. Since its discovery by Kegel, the fungus appears to have been recorded only by Bessey (1939), who found an organism in soil which he referred to this species. It seems from Bessey's few figures that the conidia which his fungus produced agreed fairly well with those of Kegel's fungus. Bessey failed to observe the conidiophores which in Kegel's material and in my own were clear and definite structures.

From the submerged alder leaves the conidiophores project at right angles into the water. I have isolated the fungus in pure culture on several occasions. On malt agar and on oatmeal agar the branched, septate mycelium builds up a compact white colony with considerable white, fleecy, aerial growth. This colony fails to form spores, but when a strip of it is immersed in water, conidiophores and conidia are produced within twenty-four hours. These conidiophores agree exactly with those produced in nature. The conidiophore (Text-fig. 39) arises from a cell of the old mycelium. It is a straight unbranched hypha usually $100-200\mu$ long and $2-3\mu$ wide and normally slightly inflated at its apex. The first conidium to develop sprouts out from this tip, but, before it has developed far, others begin to arise from the sides of the conidiophore without any reference to the original growing point of the conidiophore (Text-figs. 39, 41). While the first-formed conidium can perhaps be regarded as a phialospore, the later-formed ones are clearly radulaspores. The apical spore in its development and final form in no way differs from the lateral spores, so it seems best to regard them all as radulaspores.

The number of spores produced on a single conidiophore is usually two to six. There is no cross-wall separating the conidiophore and the conidium and a cleavage between the protoplasm of the conidiophore and that of the conidium occurs only just before spore liberation.

Each conidium is a branched system consisting of a main axis from which one, usually two or rarely three laterals grow out mostly at one side of the axis. Each of these laterals may branch again usually in the same one-sided manner, and sometimes even these themselves may branch. The hyphae which build up the branched spore are of uniform width and do not taper. At the point of origin of each branch of the spore is a narrow constriction similar to that which occurs



Text-fig. 39. *Varicosporium Elodeae* Kegel. A, conidiophore, from pure culture, developed from the inflated cells of the old mycelium and bearing two branched conidia (stippled). B, C, D, E, F and G, conidia. $\times 466$.

where the whole conidium joins the conidiophore. Very often the branches of the spore are more or less in the same plane, and because the laterals usually branch off at right angles, and because of the tendency towards the development of branches on one side only of an axis, spores of a very characteristic appearance are produced, many

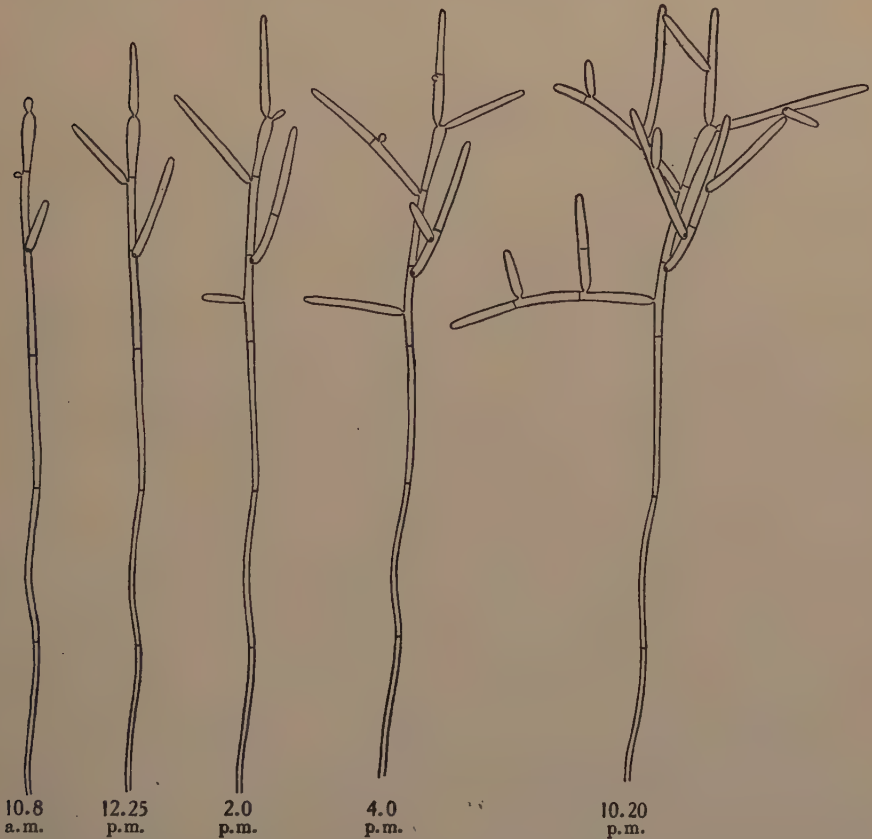


Text-fig. 40. *Varicosporium Elodeae*. Spore, twenty four hours after its liberation, producing germ tubes in water. $\times 350$.

bearing a striking resemblance to Chinese characters (Text-fig. 39 and Pl. XIV, fig. 4).

The branched spores of *Varicosporium Elodeae* differ from the branched spores of other genera of the alder-leaf flora in that the degree of branching varies considerably, so that in a spore accumulation there is a wide range of spore shape. The range is further

increased by some break-up of the spores. When a break occurs it is always at the narrow constriction at the base of a branch. The result of this fragmentation, which, however, seems to happen rather infrequently, is that a number of simple rod-shaped bodies are to be seen on examining a large spore accumulation. These vary con-



Text-fig. 41. *Varicosporium Elodeae*. Development of a conidiophore in a hanging-drop pure culture. At 10.20 p.m. there are five spores present, but none of these is probably fully grown. The conidiophore is unbranched. $\times 240$.

siderably in length. Some are relatively short and appear to be ultimate ramuli detached from larger spores. Others are relatively long and clearly are main axes of spores which have lost all their laterals, and the scars, where the branches used to be attached, are evident. However, although a branched spore may thus break up, the process is entirely one of fragmentation. There is no further

growth until the spore actually germinates. This it does readily in water, twelve to twenty-four hours after liberation, germ tubes growing out from the tips of some or all of the branches (Text-fig. 40).

When a slice of a colony on agar is transferred to deepish water all the conidiophores produced are completely submerged, but when the water is shallower, some conidiophores pierce the surface and produce spores just above the water. These spores seem to agree in all respects with those formed below the surface.

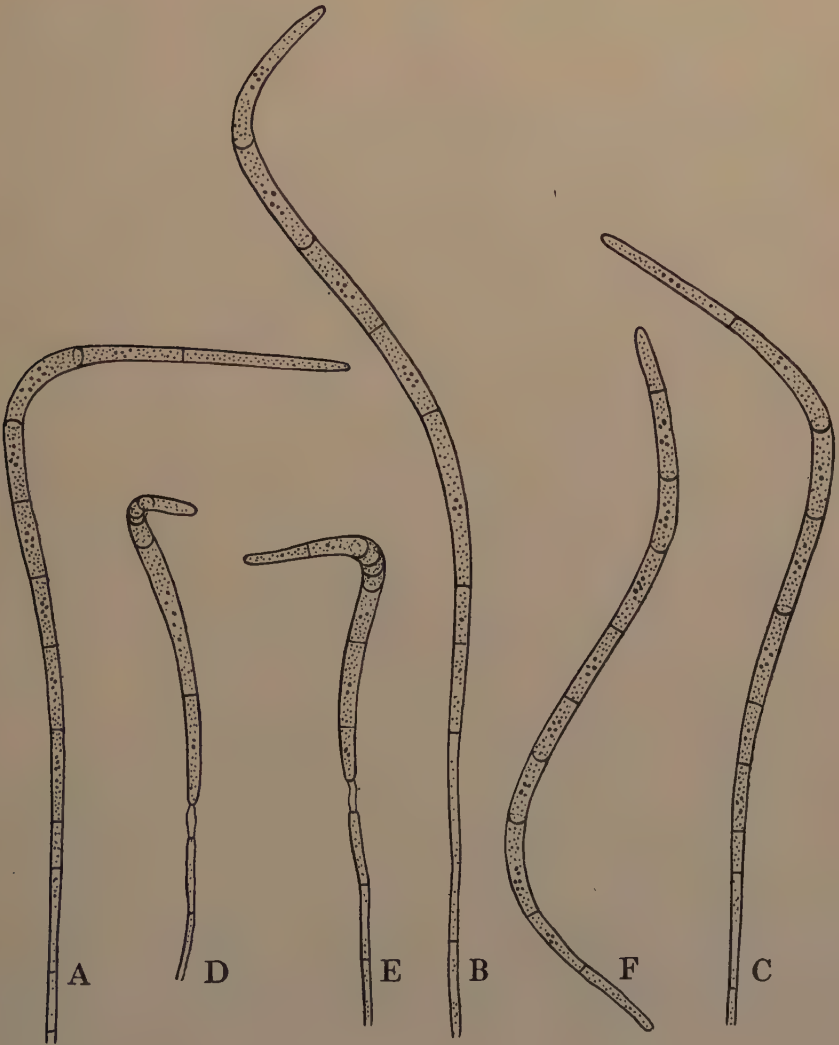
Varicosporium Elodeae Kegel

Submerged aquatic fungus with branched, septate mycelium. Conidiophore simple, $100-200\mu$ long, $2-3\mu$ wide, bearing a number (1-6) of branched conidia (radulaspores) of which one is usually terminal and the remainder lateral. Conidium consisting of a main axis ($60-120\mu$ long, 3μ wide) with one to three laterals of the same width developed on one side only of the main axis. Each of these laterals may branch again usually in the same one-sided manner. The degree of branching of the spores varies considerably. Where each spore joins the conidiophore, and at the point of origin of each branch of the spore, is a narrow constriction or isthmus. The conidia may fragment to some extent by a part of the spore breaking off at an isthmus.

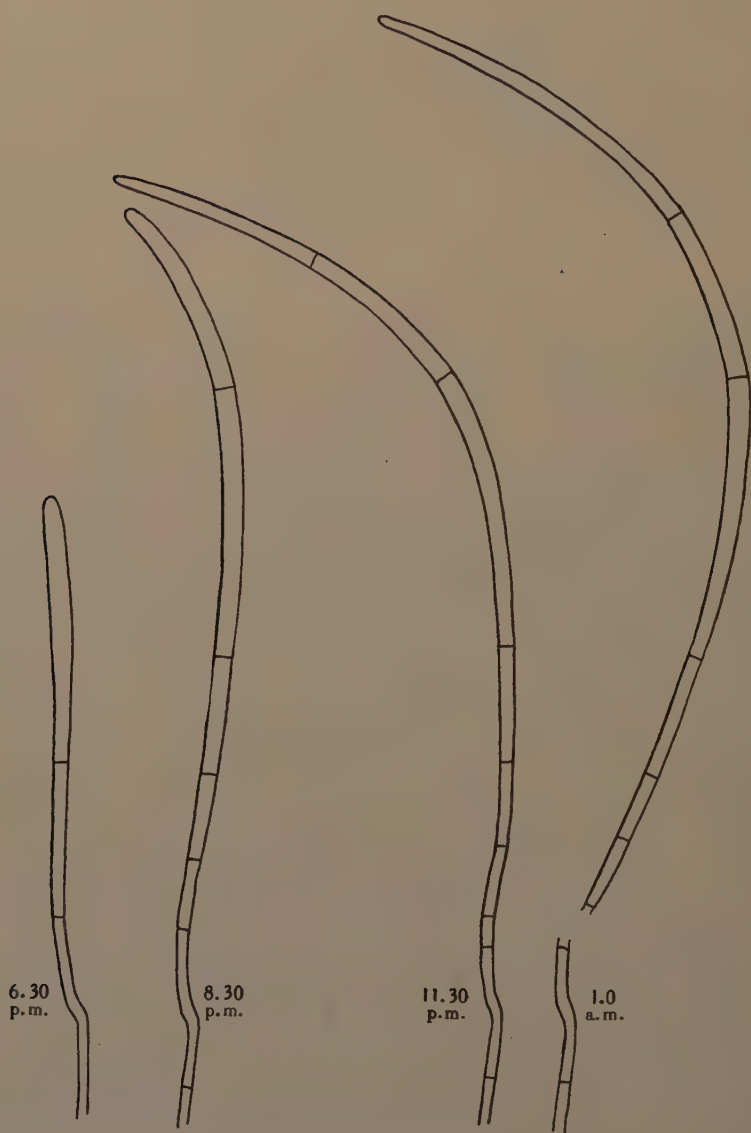
ANGUILLOSPORA LONGISSIMA (Sacc. & Syd.) n.comb.

This fungus was first described by De Wildeman (1893) under the binomial *Fusarium elongatum*, but as the specific epithet had already been used for another species it was renamed *Fusarium longissimum* by Saccardo and Sydow (in 1899, *Syll.* xiv, 1128). The justification for its removal from the genus *Fusarium* will be discussed later.

The fungus (Text-fig. 42 and Pl. XV, figs. 4, 5) was found on the decaying submerged alder and willow leaves throughout the year, and showed a marked preference for the petioles. It was often abundant. The conidiophores are usually simple, but sometimes sparingly branched and project at right angles from the leaf into the water. A simple conidiophore is a straight hypha (commonly $50-100\mu$ long), broadening gradually and passing evenly into the elongated spore. Indeed, it is impossible to be certain where the conidiophore ends and the spore begins until the 'separating cell' is differentiated. The spore primordium is an elongated cell cut off at an early stage from the conidiophore by a cross-wall (Text-fig. 43). As this cell elongates, due to the activity of its apical growing point, it undergoes curvature which is nearly always in more than one plane. At one stage the developing spore is rather like a hockey stick (Pl. XV, fig. 4), but usually it finally becomes somewhat sigmoid. During its



Text-fig. 42. *Anguillospora longissima* (Sacc. & Syd.) n.comb. A, B and C, conidiophores each with a terminal conidium. In these examples it is not certain where the conidiophore stops and the conidium (aleuriospore) begins. D and E, conidiophores drawn at the stage where the separating cell is breaking down. In D and E the middle zone of the spore is greatly foreshortened. F, liberated spore. All $\times 520$.



Text-fig. 43. *Anguillospora longissima*. Aleuriospore development. At 8.30 p.m. the separating cell is not yet cut off from the conidiophore, but it is formed by 11.30 p.m. and has broken down to liberate the spore by 1 a.m. From hanging-drop pure culture. $\times 540$.

development septation occurs, so that when the spore is ripe it is usually divided into eight to twelve cells. The mature spore is 200–350 μ long and 5–6 μ broad. During development, at the end of the conidiophore, a short cell is cut off which is destined to become the separating cell. When the spore is ripe this cell breaks down. First, a line of weakness becomes apparent, girdling the cell. Then its contents disappear, the cell wall splits along this line of weakness and thus the spore is liberated. In a spore which has just escaped from its conidiophore a little basal collar representing the remains of the upper half of the separating cell can be seen, but this is very soon rendered invisible by the bulging of the cross-wall just above it which fills or may exceed the collar. A similar collar is to be seen at the apex of the old conidiophore. This method of spore liberation agrees exactly with that found in *Tetrachaetum* and with that observed by Dowding and Orr (1939) in the aleuriospores of the dermatophyte, *Microsporum lanosum*.

The fungus has been isolated in pure culture. On malt agar a branched septate mycelium forms a compact colony which is, in the main, almost black, with a slight greenish tinge, and surrounded by a white fringe of young hyphae (Pl. XVII, fig. 2). In the black region there is much greyish brown aerial growth. Both on malt agar and on oatmeal agar spore formation fails, but when a strip of colony is submerged in water, sporophores and spores, exactly like those formed on the alder leaves, are developed within thirty-six hours.

The spore germinates readily in water with a germ tube from each end.

In *Fusarium* the long fusiform spores on which the genus is largely based is a phialospore. In the present species the very long sigmoid or sickle-shaped spores are aleuriospores. In their monograph of the genus *Fusarium* Wollenweber and Reinking (1935) make the tentative suggestion that *F. elongatum* De Wild. is a species of *Cylindrocarpon*, but again in that genus the elongated conidium is a phialospore. So far as I can see the closest similarity is with the elongated macroconidia of *Microsporum lanosum* which are also liberated in the same way as those of the present species. However, it would be out of the question to associate an aquatic saprophyte with a genus of specialized dermatophytes. It seems best to regard the present species as the type of a new genus, and because of the eel-like appearance of the spore the generic name *Anguillospora* is proposed.

***Anguillospora* n.gen.**

Submerged aquatic fungi with branched, septate mycelium. Conidium (aleuriospore) terminal, eel-like, septate, hyaline, separating from the conidiophore by the breakdown of a separating cell at the end of the conidiophore.

Anguillospora longissima (Sacc. & Syd.) n.comb.

Submerged aquatic fungus with branched, septate mycelium which is hyaline when young, becoming greenish grey when old. Conidiophore usually simple, 50–150 μ long, 2–4 μ broad. Conidium (aleuriospore) terminal, 200–350 μ long, 5–6 μ broad in the middle region, tapering to 3–4 μ broad at the ends, 6–10 septate, curved or sigmoid, separating when mature by the breakdown of a small ‘separating cell’ at the end of the conidiophore.

✓ *Anguillospora* gen.nov.

[Lat. *anguilla*, an eel, from the shape of the spores.]

Fungi aquatici submersi, mycelio repente, septato, ramoso. Conidiophora hyalina, filiformia, erecta. Conidia (aleuriosporae) acrogena, elongata, vermiformia vel anguilliformia, septata, hyalina, e conidiophoro cellulae brevis fractura separantia.

Anguillospora longissima (Sacc. & Syd.) n.comb.*FLAGELLOSPORA CURVULA* n.gen., n.sp.

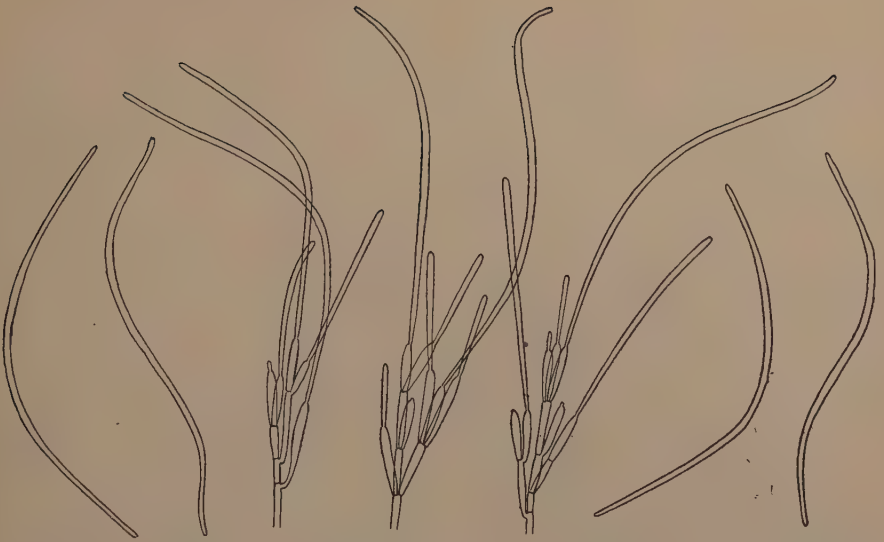
This fungus (Text-figs. 44, 45 and Pl. XV, fig. 6) was observed very frequently and often in abundance during October and November, but it was rather rare at other times. So far it has not been grown in pure culture, although several attempts have been made to isolate it. The conidiophore is usually branched to give a clump of two to twelve phialides, and if a basal unbranched region is present it is very short (Text-fig. 44). From the tip of each phialide conidia (phialospores) are produced in basipetal succession (Text-fig. 45). The mature conidium is curved like a very open **C** or more usually an open **S**, but the curvature is not in one plane. The length of the spore varies from 100 μ to 150 μ and the width is about 2 μ . It is non-septate when shed, but occasional septa may appear subsequently. The spore germinates readily in water, a narrow germ tube developing from either or both ends.

The general form of the spore shows a close resemblance to that of *Anguillospora longissima*, but the spores of the present species differ (i) in being phialospores and not aleuriospores, (ii) in the shorter length and lesser width, and (iii) in being non-septate when shed.

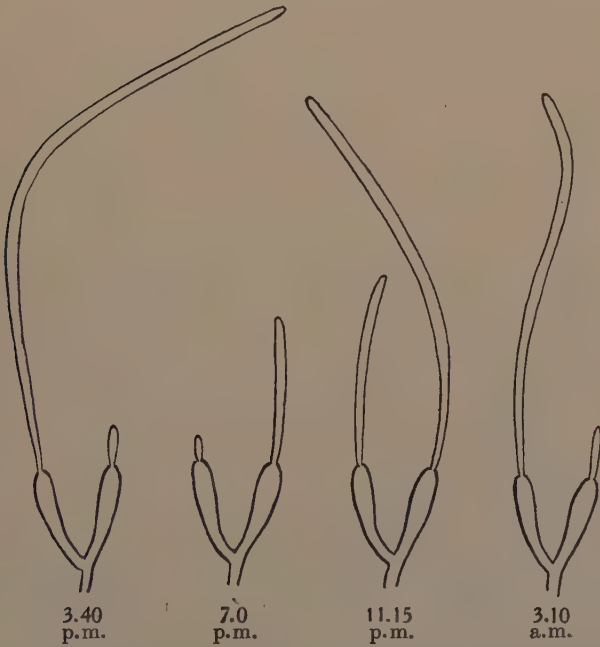
The generic name for this fungus is suggested by the whip-like appearance of the spores.

. **Flagellospora** n.gen.

Submerged aquatic fungi with branched septate mycelium. Conidiophore branched to form a number of phialides. Conidia (phialospores) hyaline, filiform, produced in basipetal succession.



Text-fig. 44. *Flagellospora curvula* n.gen., n.sp. Three conidiophores and four liberated conidia. From submerged alder leaves. $\times 486$.



Text-fig. 45. *Flagellospora curvula*. Conidiophore consisting of two phialides showing spore development. At 3.30 p.m. the spore on the left-hand phialide was nearly full-grown and was shed between 4 p.m. and 5 p.m. From a piece of decaying alder leaf in a hanging-drop. $\times 740$.

Flagellospora curvula n.sp.

Submerged aquatic fungus with branched, septate mycelium. Conidiophore usually branched forming a group of two to ten phialides. Each phialide, clavate, $10-20\mu$ long, 2.5μ broad, producing conidia (phialospores) in basipetal succession. Conidium curved or sigmoid, hyaline, unicellular, $100-150\mu$ long, 2μ broad in middle region tapering to 1.5μ towards its ends.

On submerged decaying leaves of *Alnus glutinosa* and *Salix* sp. from a stream in Leicestershire, England.

✓ *Flagellospora* gen.nov.

[Lat. *flagellum*, a whip, from the shape of the spores.]

Fungi aquatici submersi, mycelio repente, septato, ramoso. Conidiophora hyalina, septata, apice ramosa, phialides gerentia. Conidia (phialosporae) hyalina, filiformia, continua, ex eodem loco deinceps exorientia.

✓ *Flagellospora curvula* sp.nov.

Fungus omnino submersus, mycelio hyalino, septato, ramoso. Conidiophora hyalina, apice ramosa, 2-10 phialides clavatas $10-20\mu \times 2.5\mu$ gerentia. Conidia ex eadem phialide deinceps evoluta, filiformia, curvata vel sigmoidea, hyalina, continua, $100-150\mu$ longa, medio 2μ lata, utrinque ad 1.5μ attenuata.

Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

LUNULOSPORA CURVULA n.gen., n.sp.

This handsome fungus (Text-figs. 46-48 and Pl. XV, fig. 7) was found very abundantly on decaying submerged alder and willow leaves, especially during late summer and autumn. During the winter and spring it was rather rare. The conidiophores project in miniature forests from the petioles and large veins of the decaying leaves. It has been isolated in pure culture on several occasions. The branched septate mycelium forms, on malt agar, a compact colony with very little aerial growth (Pl. XVII, fig. 4). In the older regions the hyphae become dark olive-green. When an old colony is examined the dark green region is of very irregular form, often consisting of a small central irregular star. The colony fails to form spores, but when a strip of it is submerged in water, conidiophores bearing spores are produced within twenty-four hours. These show complete agreement with those formed in nature on the decaying submerged leaves. The conidiophore juts out at right angles to the substratum and is a completely submerged structure.

The main axis of the conidiophore is usually a simple straight hypha, or it may branch, but very rarely more than once. A simple



Text-fig. 46. *Lunulospora curvula* n.gen., n.sp. Conidiophores with spores at various stages of development and three liberated spores in each of which the 'hilum' is showing. From submerged decaying alder leaves. All $\times 440$.

conidiophore starts as a straight hypha arising from the old mycelium. From its end a cell is delimited by a cross-wall (Text-fig. 47 B). It is from this cell that the spore and its stalk are all finally developed.

Very soon from the basal region of this cell a short stalk cell is cut off by a cross-wall (Text-fig. 47 C). The upper cell is the spore-initial. At first this cell has a single growing point which is apical, but soon a new growing point differentiates at the base of the spore-initial and just to one side of its junction with the stalk cell (Text-figs. 47, 48). These two growing points now proceed to develop until a crescent-shaped, or sometimes sigmoid, spore is formed. This is liberated by the breakdown of the stalk cell. While the development of the first spore is proceeding a new spore-plus-stalk-cell primordium is beginning to form. This appears as an outgrowth from the conidiophore immediately to one side of the separating cell of the first spore (Text-fig. 48). It is very soon cut off by a cross-wall, thus producing the cell which is the new spore-plus-stalk-cell initial, and which develops in the same way as the first. After the first spore is shed, and while the second spore is developing, a third spore-plus-stalk-cell primordium usually buds out from the conidiophore apex. Thus from the end of the same conidiophore a number of spores may be produced just as in *Articulospora tetracladia* and in *Tricladium angulatum*. Spore development at laboratory temperature takes about ten hours, and usually at the apex of a conidiophore; if a nearly ripe spore is present, another developing spore about five hours younger is to be seen beside it. Occasionally at an apex three spores are to be seen all at different stages. The spore is clearly an aleuriospore.

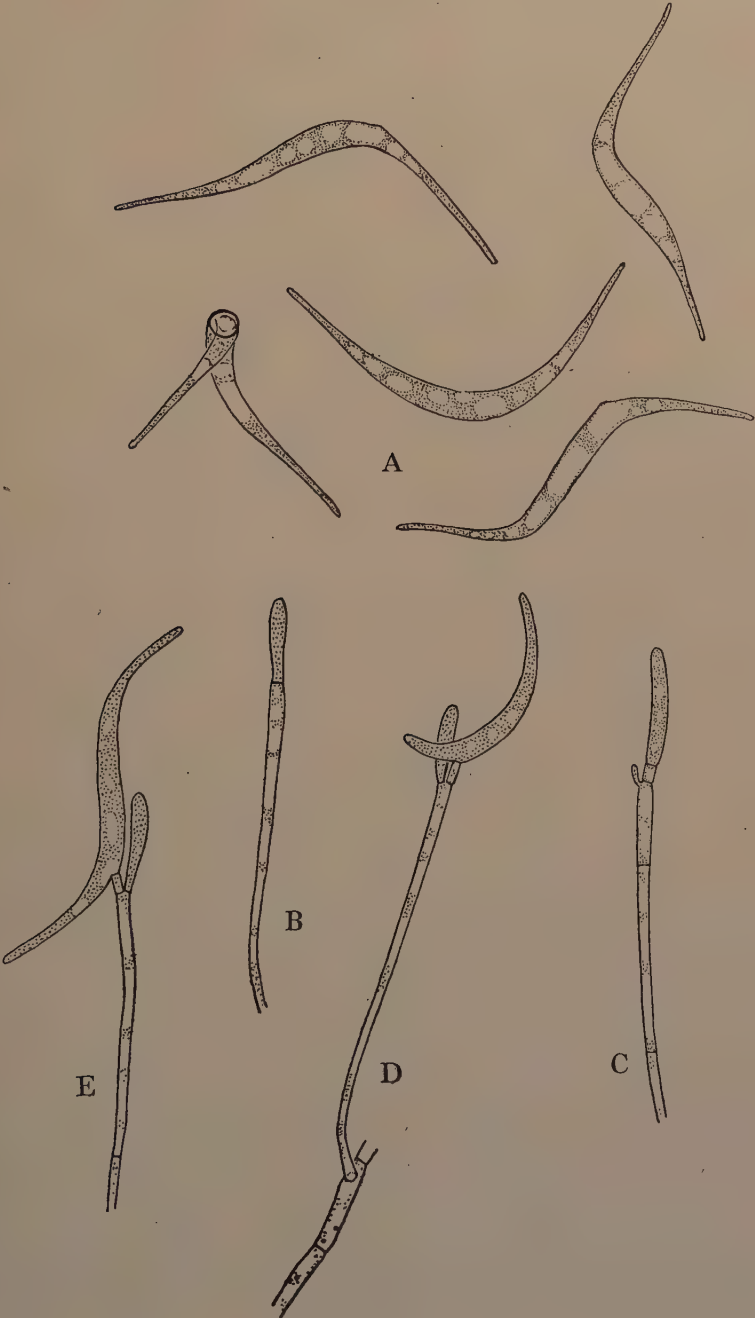
In the liberation of the spore the stalk cell or separating cell completely disintegrates. There is no collar-like portion left attached to the spore and to the conidiophore as in *Anguillospora longissima* and in *Tetrachaetum elegans*.

The crescent-shaped or sigmoid spore is usually bent in a three-dimensional curve. It is unicellular, 70–90 μ long, 6 μ broad at its widest part, but tapers gradually to 1 μ at its tips. There is usually a distinct hilum where the spore was originally attached to its stalk cell. A characteristic feature is the row of six to eight large vacuoles in the spore separated by highly refractive bridges of protoplasm. This internal structure gives the spore a very striking appearance.

The spores germinate readily in water, a narrow germ tube developing from one or both of the tips of the spore.

Legend to Text-fig. 47

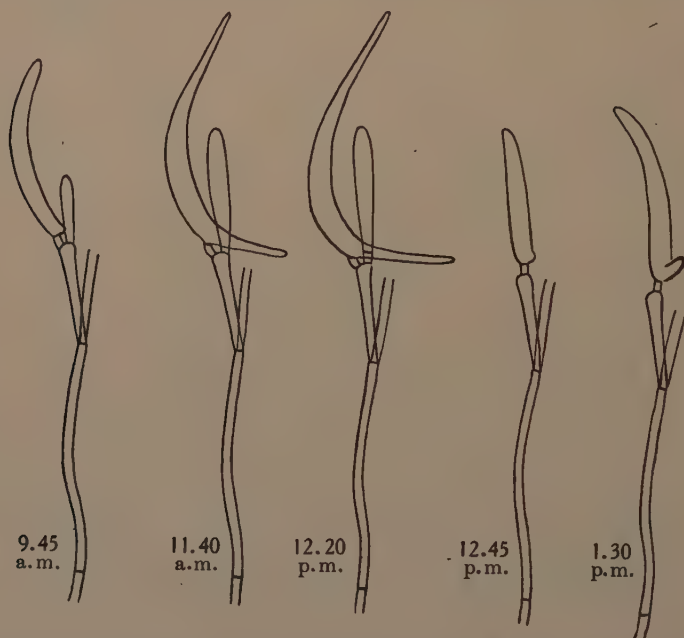
Text-fig. 47. *Lunulospora curvula*. A, liberated spores. B, C, D and E, young conidiophores which have not yet shed any spores. B, very young conidiophore from the apex of which the first spore-plus-stalk-cell primordium is cut off. C, a slightly later stage in which the stalk cell is cut off, but the spore primordium has still only an apical growing point; a new spore-plus-stalk-cell primordium is just beginning to form to the left of the stalk cell. D and E, later stages in which the developing spore has become crescent-shaped (D) or sigmoid (E). In D the conidiophore is shown arising from the vegetative mycelium. In both D and E there is a developing spore-plus-stalk-cell primordium immediately to one side of the stalk cell of the maturing spore. All from pure culture. $\times 660$.



Text-fig. 47.

Lunulospora n.gen.

Submerged aquatic fungi with branched, septate mycelium. Conidiophore simple or branched. Conidium (aleuriospore) unicellular, sigmoid or crescent-shaped, borne terminally on the conidiophore on a small stalk cell attached not to an end of the spore but at a point some way from either end. Spore liberated by the breakdown of the stalk cell.



Text-fig. 48. *Lunulospora curvula*. Spore development. For simplicity one only of the two spore-producing apices of the conidiophore has been figured. The first spore was shed at 12.30 p.m. From a piece of decaying alder leaf in a hanging-drop. $\times 740$.

***Lunulospora curvula* n.sp.**

Submerged aquatic fungus with branched, septate mycelium. Conidiophore simple or sparingly branched, $50-200\mu$ long, $2-2.5\mu$ broad. Conidium (aleuriospore) produced terminally on a short stalk cell $3-5\mu$ long, 1.5μ broad. By repeated budding from the end of the conidiophore a number of spores may be produced in succession (but not basipetally), each seated on a stalk cell. Aleuriospore unicellular, crescent-shaped or sigmoid, $70-90\mu$ long, $4-5\mu$ broad in its middle region, tapering to 1.5μ at its ends, with a row of conspicuous vacuoles, attached at a point along its convex surface to the stalk cell. Aleuriospore liberated by the breakdown of the stalk cell. Liberated

spore with an inconspicuous hilum where it was originally attached to the stalk cell.

On submerged decaying leaves of *Alnus glutinosa* and *Salix* sp. from a stream in Leicestershire, England.

Lunulospora gen.nov.

[Lat. *lunula*, a little moon, from the shape of the spore.]

Fungi aquatici submersi, mycelio repente, septato, ramoso. Conidiophora hyalina, simplicia vel ramosa. Conidia (aleuriosporae) acrogena, hyalina, continua, lunata vel sigmoidea, latere convexo prope basim ad pedicellum brevem affixa.

Lunulospora curvula sp.nov.

Fungus aquaticus submersus, mycelio repente primo hyalino demum olivaceo-fuscescente, septato, ramoso. Conidiophora hyalina, simplicia vel parce ramosa, filiformia, erecta, 50–200 μ longa, 2–2.5 μ lata. Conidia (aleuriosporae) acrogena, hyalina, continua, lunata vel sigmoidea, 70–90 μ $\times$ 4–5 μ , utrinque ad 1.5 μ attenuata, guttulis plurimis praedita, latere convexo prope basim ad pedicellum brevem 3–5 $\times$ 1.5 μ affixa; ex eodem conidiophoro conidia compluria quaeque pedicellata deinceps exoriri possunt; pedicelli dissolutione conidium liberatur et cicatricem exhibuit.

Hab. In foliis putrescentibus *Alni glutinosae* et *Salicis* sp. in flumine jacentibus, Leicestershire, Anglia.

DISCUSSION

The fungi described above represent the main constituents of the regular fungous flora of decaying submerged alder leaves as observed in a single stream in Leicestershire. I have made no thorough examination of leaves from other localities, and further, I have undertaken no systematic search of substrata other than the alder leaves in the stream. The stream is a small one with alders and occasional willows by its banks, and most of the organic debris of the stream-bed consists of leaves from these trees. Such leaves can be found throughout the year in great abundance during autumn and winter, but become scarce in late spring and early summer. Then the new season's leaves begin to fall in small numbers and appear in the stream-bed. Thus decaying leaves are present in the stream throughout the year, and nearly all the aquatic Hyphomycetes described above have been collected from such leaves in every month of the year. I have occasionally looked at decaying willow leaves from the stream, but, although most of these fungi have been seen on these leaves, their development is poor indeed compared to that on the alder leaves.

The fungal flora of the alder leaves appears in the main to be dominated by these fungi, although a species of *Actinomyces* is often abundant in leaves which are in the last stages of decay, and water moulds belonging to the genera *Pythium* and *Phytophthora* are frequent but rarely abundant members of the flora. It is when the decaying leaves are tending to become leaf skeletons that the aquatic Hyphomycetes reach their best development, and when leaves of this type were examined it was extremely rare to find one without any of these fungi. Usually on any one leaf between four to eight species were present.

One of the most outstanding features of these Hyphomycetes of the submerged decaying leaves is the fact that normally the spores are produced, liberated and dispersed below water. It is true that as well as submerged spores *Margaritispora aquatica*, *Heliscus aquaticus* and *Varicosporium Elodeae* can also, if the water is sufficiently shallow (i.e. if the leaf is within a millimetre of the surface), produce spores just above the water level, which are liberated on to the surface film, and, further, in *Heliscus aquaticus* and in *Tetracladium Marchalianum* spores are produced in sticky heaps in pure culture on solid agar. However, in these four species the submerged spore appears to be the normal condition, and in the other twelve members of the flora, both in nature and in culture, I have observed only submerged spores.

Probably most Hyphomycetes can be grown as aquatic organisms on a suitable liquid medium, but under these conditions, if definite conidiophores are formed, the conidia are usually produced only at the surface and the conidiophores are aerial structures.

In their recent list of British Hyphomycetes Wakefield and Bisby (1941), influenced by Mason's insistence on the importance of the distinction between 'slime spores' and 'dry spores', have divided Hyphomycetes into two primary divisions distinguished by these characters. Genera based on a 'dry-spore' form are placed in the Xerosporae, and those based on a 'slime-spore' form are classified in the Gloiosporae. As has already been suggested above (p. 343), the spore, produced, liberated and dispersed below water, really represents a third biologic type of spore, the 'submerged aquatic spore', and the question if a third group of Hyphomycetes should be recognized naturally arises. For the moment it seems best to avoid needless complication of the classification by extending the definition of the Gloiosporae to include genera based on a slime spore or on a submerged aquatic spore rather than to introduce a new group. The adoption of this course is further supported by the fact that in two species (*Tetracladium Marchalianum* and *Heliscus aquaticus*) the same spore type may either be an aquatic spore (as in nature) or a slime spore (as in cultures on agar).

The cultural characters of the thirteen species of the alder-leaf

flora which have been isolated vary considerably, so that it would be simple to construct a key by which each of these species could be identified from its fellows on cultural features alone. In some species, the older parts of the mycelium become dark green or almost black (e.g. *Tricladium splendens*, *Anguillospora longissima*, *Lunulospora curvula* and *Clavariopsis aquatica*). In *Lemonniera aquatica* the older regions of the colony become bright brown and finally dark brown. In *Tetraccladium Marchalianum* the colony has a pale yellowish or creamy tinge. In the remaining species the colony is white, except that in *Margaritispora aquatica* it is dotted with dark brown sclerotia. When grown on malt agar the leading hyphae of the growing margin of the colony are 3–4 μ wide in all species with the exception of *Alatospora acuminata* in which these hyphae are somewhat finer and do not exceed 2.5 μ . In many species there is little growth of aerial hyphae (e.g. *Lunulospora curvula*, *Tricladium angulatum*, *Alatospora acuminata*), but others produce a strong aerial mycelium (e.g. *Tricladium splendens*, *Varicosporium Elodeae* and *Tetrachaetum elegans*). All species agree, however, in forming very compact colonies, and in nearly all, mycelial cords are developed each consisting of several parallel strands of hyphae often twisted as in a rope.

Although both *Heliscus aquaticus* and *Margaritispora aquatica* exhibit a dimorphism of the phialospores conditioned by the environment in which spore development occurs, *Clavariopsis aquatica* is the only species of this flora which has so far been found to produce two distinct spore forms, namely, aquatic aleuriospores and pycnidiospores which, however, have been observed only in culture.

In considering the Hyphomycetes of the submerged decaying leaves, the remarkable shape of the spores in most species forces itself on the observer's attention. In most of the species the spore is a branched structure, and in most genera it consists of four branches diverging from a common point. When, however, the development of the branched spore in the different genera is considered, the mode of formation is so different that one is driven to the conclusion that the similarity in general spore shape is the result of parallel evolution.

If the branched spore has been evolved along a number of distinct lines of evolution, it would seem likely that it has a survival value in the environment in which these fungi grow. Living as they do on decaying leaves in the stream-bed, the dispersal of their spores involves three rather distinct problems: (i) spore liberation, (ii) the actual dispersal, and (iii) the coming to rest of the spore on a suitable substratum. It is, perhaps, in the solution of the third problem that the four-armed or branched spore plays its part, since such a spore would probably stand a much greater chance of becoming entangled in the decaying leaves of the stream-bed than an ovoid or spherical one. However, it must be remembered that both *Margaritispora*

aquatica, with a nearly spherical submerged spore, and *Heliscus aquaticus*, with a spore having arms probably too short to have any value in securing entanglement, find a place in the aquatic alder-leaf flora.

If the biological value of the four-armed spore does, in fact, lie in the ease with which it becomes entangled in the alder leaves, then the same value may also be expected to reside in the long curved or sigmoid spores, occupying a curvature in more than one plane, which characterize *Anguillospora*, *Flagellospora* and *Lunulospora*. Again, in these three genera, although there is great similarity in the mature spore shape, spore development is so different that any close phylogenetic relationship between the three can scarcely be suggested. Both the branched spore and the elongated spore with a three-dimensional curvature represent types which probably tend to become entangled in the decaying leaves as they are trundled along the stream-bed by the current.

If this explanation of the biological value of the branched and elongated spore is correct, it also suggests a biological value for the conidiophores. In all species the conidiophore is a very definite structure which grows out at right angles to the substratum, with the result that when disjunction occurs, the spore is liberated at a short distance from the substratum and thus stands a reasonable chance of being carried away without becoming entangled in the immediate substratum.

It is, of course, very unsafe to assume function from form, and the biological value, if any, of the branched spore may be of quite a different character. It is easy to imagine other possibilities. For example, water fleas and rotifers probably devour a large number of spores of aquatic fungi, and whether a spore is eaten or not may depend on its size and shape, so that, possibly, the value of the branched spore, and of the elongated spore with a three-dimensional curvature, lies in the difficulty which small predators have in consuming objects of such shapes.

Finally, it must be emphasized that, although the branched spore may have a special survival value in the aquatic environment in which these organisms grow, fungi growing in a completely different habitat may develop the same type of spore which may, in this habitat, have a different biological value or no value at all. Drechsler (1934, 1937, 1940) has in recent years described a number of Hyphomycetes which parasitize rhizopods and nematodes in leaf mould. Some of these (e.g. *Tridentaria implicans*, *T. carnivora* and *Pedilospora dactylopaga*) have a branched type of spore very like that of some of the aquatic alder-leaf fungi. In these fungi the branched spore cannot be concerned with aquatic life, since the fungi are terrestrial and the spores are borne on aerial conidiophores.

SUMMARY

An account is given of a flora of submerged aquatic Hyphomycetes growing on decaying leaves of alder and willow in a stream. The flora consists of sixteen species belonging to thirteen genera. The majority of these fungi produce conidia which are branched, and in most of these species the conidium consists of four divergent arms. In three species, belonging to different genera, an elongated spore with a three-dimensional curvature is produced. Only in one species is the spore more or less spherical.

The following fungi, already known to science, are members of the flora: *Lemonniera aquatica* De Wild., *Clavariopsis aquatica* De Wild., *Varicosporium Elodeae* Kegel, and *Tetracladium Marchalianum* De Wild., although a more restricted definition is proposed for the last species. *Tridentaria setigera* Grove is reported, but it is suggested that this species should be removed to the genus *Tetracladium* and the binomial *T. setigerum* (Grove) n.comb. is suggested. The relationship between the genera *Titaea* and *Tetracladium* is discussed, and it is pointed out that *Titaea maxilliformis* Rostr. should be regarded as a species of *Tetracladium*. Of the three species with elongated spores the only one which seems to be referable to a known species is *Fusarium longissimum* Sacc. & Syd. (= *F. elongatum* De Wild.). It is pointed out that this species cannot be regarded as belonging to *Fusarium*, and the name *Anguillospora longissima* (Sacc. & Syd.) n.comb., is proposed.

The remaining ten species belonging to seven genera appear to be new to science. These are as follows: *Margaritispora aquatica* n.gen., n.sp., *Articulospora tetracladia* n.gen., n.sp., *Tetrachaetum elegans* n.gen., n.sp., *Tricladium splendens* n.gen., n.sp., *T. angulatum* n.sp., *Heliscus aquaticus* n.sp., *H. longibrachiatus* n.sp., *Alatospora acuminata* n.gen., n.sp., *Lunulospora curvula* n.gen., n.sp., and *Flagellospora curvula* n.gen., n.sp.

Of the sixteen alder-leaf Hyphomycetes, all except three (*Tetracladium setigerum*, *Heliscus longibrachiatus* and *Flagellospora curvula*) have been grown in pure culture on malt agar and oatmeal agar.

In some genera (*Clavariopsis*, *Tetracladium*, *Articulospora*, *Tetrachaetum*, *Tricladium*, *Lunulospora* and *Anguillospora*) the spore form on which the genus is based is an aleuriospore, while in others (*Lemonniera*, *Margaritispora*, *Heliscus*, *Alatospora* and *Flagellospora*) it is a phialospore. In *Varicosporium* the spore is probably best regarded as a radulaspore.

The possible biological value of the branched spore and of the long, curved spore is discussed, and it is suggested that this value may lie in the ease with which these spores become entangled in the decaying leaves of the stream-bed.

It is suggested that in fitting these fungi into the recent scheme of

classification of Hyphomycetes proposed by Wakefield and Bisby (1941), the best plan is to place them in the Gloiosporae, and to extend the definition of that group to include not only genera based on 'slime spores' but also genera founded on 'aquatic spores' produced, liberated and normally dispersed below water.

My thanks are due to Dr B. Barnes, Dr C. G. C. Chesters, Mr E. W. Mason and Dr J. Ramsbottom, who have discussed these fungi with me and who have given me most valuable advice and helpful criticism, and especially my warmest thanks are due to Miss E. M. Wakefield, who has not only helped me with valuable advice but who also undertook the laborious task of composing the Latin diagnoses of the new genera and species.

REFERENCES

- BARNES B. & MELVILLE, R. (1932). Notes on British aquatic fungi. *Trans. Brit. myc. Soc.* xvii, 82-96.
- BESSEY, E. A. (1939). *Varicosporium Elodeae* Kegel, an uncommon soil fungus. *Papers Michigan Acad. Sci., Arts and Lett.* xxv, 15-17.
- BRUTSCHY, A. (1927). *Tetracladium Marchalianum* De Wildeman. Ein nur wenig beachteter Wasserpilz. *Mikrokosmos* [Stuttgart], xxi, 145-6. Cited in *Biol. Abs.* (1930), iv, 2113.
- DE WILDEMAN, E. (1893). Notes mycologiques. Fascicle 2. *Ann. Soc. Belge Microsc.* xvii, 35-68.
- DE WILDEMAN, E. (1894). Notes mycologiques. Fascicle 3. *Ann. Soc. Belge Microsc.* xviii, 135-61.
- DE WILDEMAN, E. (1895). Notes mycologiques. Fascicle 6. *Ann. Soc. Belge Microsc.* xix, 191-232.
- DOWDING, E. S. & ORR, H. (1939). The dermatophyte *Microsporum lanosum*. *Mycologia*, xxxi, 76-92.
- DRECHSLER, C. (1934). *Pedilisporea dactylopaga* n.sp., a fungus capturing and consuming testaceous rhizopods. *J. Wash. Acad. Sci.* xxiv, 395-402.
- DRECHSLER, C. (1937). A species of *Tridentaria* preying on *Diffugia constricta*. *J. Wash. Acad. Sci.* xxvii, 391-8.
- DRECHSLER, C. (1940). Three new hyphomycetes preying on free-living terricolous nematodes. *Mycologia*, xxxii, 448-70.
- ELLIS, J. B. & EVERHART, B. M. (1891). New species of fungi from various localities. *Proc. Acad. Nat. Sci. Philadelphia*, pp. 76-93.
- GROVE, W. B. (1912). New or noteworthy fungi. Pt. IV. *J. Bot.* l, 9-18.
- VON HÖHNEL, F. (1904). Mycologische Fragmente. *Ann. Myc.* ii, 38-60.
- VON HÖHNEL, F. (1914). Fragmente zur Mykologie. Pt. XVI. *Sitz. K. Akad. Wien Naturw.* cxxiii, 49-146.
- HOLTERMANN, C. (1898). *Mykologische Untersuchungen aus den Tropen*. Berlin.
- HUBER-PESTALOZZI, G. (1925). Zur Morphologie und Entwicklungsgeschichte von *Asterothrix* (*Cerasterias*) *raphidioides* (Reinsch) Printz. *Hedwigia*, lxxv, 169-78.
- KARLING, J. S. (1935). *Tetracladium Marchalianum* and its relation to *Asterothrix*, *Phycium* and *Cerasterias*. *Mycologia*, xxvii, 478-95.
- KEGEL, W. (1906). *Varicosporium Elodeae*, ein Wasserpilz mit auffallender Konidienbildung. *Ber. d.d. bot. Ges.* xxiv, 213-16.
- LINDAU, G. (1904-1910). *Rabenhorst's Kryptogamen-Flora*. Vol. i, Pilze. Pts. VIII and IX. Fungi Imperfecti. Leipzig.
- MASON, E. W. (1933). *Annotated account of fungi received at the Imperial Mycological Institute*. List II, Fascicle 2.

Hyphomycetes of Decaying Alder Leaves. C. T. Ingold 415

- MASON, E. W. (1937). *Annotated account of fungi received at the Imperial Mycological Institute*. List II, Fascicle 3.
- PERTY, M. (1852). *Zur Kenntniss kleinster Lebensformen*. Bern.
- PRINTZ, H. (1914). Kristianialraktens Protococcoideen. *Skr. Vidensk. Math.-Nat. Kristiana*, VI, 1-123.
- REINSCH, P. F. (1888). *Familiae Polyedricarum Monographia*. *Notarisia*, III, 493-516.
- ROSTRUP, E. (1894). Mykologiske Meddelelser IV. *Bot. Tidssk.* XIX, 36-47.
- SACCARDO, P. A. (1876). Fungi veneti novi vel citici. Ser. v. *Nuovo Giorn. Bot. Ital.* VIII, 161-211.
- SACCARDO, P. A. (1880). *Conspectus generum fungorum Italiae inferiorum*. *Michelia*, II, 1-38.
- SCOURFIELD, D. J. (1940). The microscopic life of the 'leaf-carpet' of woods and forests. *Essex Naturalist*, XXVI, 231-46.
- TROTTER, A. (1904). Notulae mycologicae. *Ann. Myc.* II, 533-88.
- VUILLEMIN, P. (1910). Matériaux pour une classification rationnelle des Fungi Imperfecti. *Compt. rend. Acad. Sci.* CL, 882-4.
- VUILLEMIN, P. (1911). Les Aleuriosporés. *Bull. Soc. Sci. Nancy*, III, XII, 151-75.
- WAKEFIELD, E. M. & BISBY, G. R. (1941). List of Hyphomycetes recorded from Britain. *Trans. Brit. myc. Soc.* XXV, 49-126.
- WILTSHIRE, S. P. (1938). The original and modern conceptions of *Stemphylium*. *Trans. Brit. myc. Soc.* XXI, 211-39.
- WOLLENWEBER, H. W. & REINKING, O. A. (1935). *Die Fusarien*. Berlin.

EXPLANATION OF PLATES XII-XVII

PLATE XII

- Fig. 1. *Lemonniera aquatica* De Wild. Conidiophore with two phialides. That on the right bears a very young phialospore. That on the left bears a spore in which the developing arms have grown to about half of the final length. From pure culture. $\times 525$.
- Fig. 2. *Lemonniera aquatica*. Three spores. From pure culture. $\times 173$
- Fig. 3. *Margaritispora aquatica* n.gen., n.sp. Upper part of a conidiophore with six phialides. The phialide on the extreme right shows a young conidium developing just below a fully formed phialospore. From pure culture. $\times 525$.
- Fig. 4. *Margaritispora aquatica*. Liberated spores. $\times 525$.
- Fig. 5. *Margaritispora aquatica*. Germinating spore. $\times 525$.
- Fig. 6. *Clavariopsis aquatica* De Wild. Two conidiophores. In each the arrow indicates the junction of the spore and the conidiophore. From pure culture. $\times 325$.
- Fig. 7. *Clavariopsis aquatica*. Aleuriospores. From pure culture. $\times 173$.
- Fig. 8. *Heliscus aquaticus* n.sp. Conidiophore with two phialides. The spore on the right-hand phialide is nearly mature. The spore on the left-hand phialide is at an early stage of development. From pure culture. $\times 525$.
- Fig. 9. *Heliscus aquaticus*. Spore from stream water. $\times 525$.
- Fig. 10. *Heliscus aquaticus*. Three spores. The uppermost one is a surface spore formed aerially; the two lower spores were formed below water. From pure culture. $\times 325$.
- Fig. 11. *Heliscus aquaticus*. Conidia from a sporodochium formed in pure culture. $\times 400$.

PLATE XIII

- Fig. 1. *Tetracadium setigerum* (Grove) n.comb. Conidiophore with two developing conidia at its apex. That on the left is nearly mature and has three parallel finger-like processes in addition to the four divergent arms. Of these the arm curving to the left towards the observer is somewhat out of focus. The developing aleuriospore on the right is very young and is still an unbranched structure. From submerged alder leaf. $\times 680$.

PLATE XIII (continued)

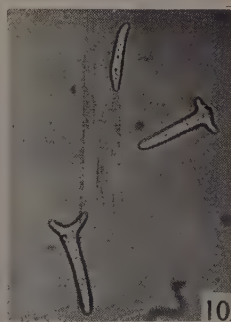
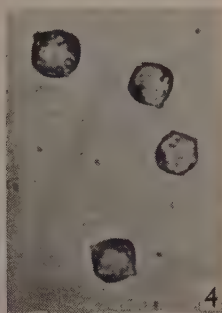
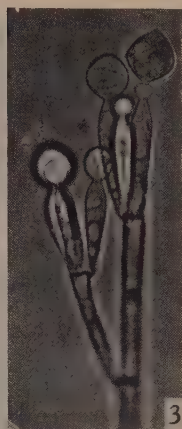
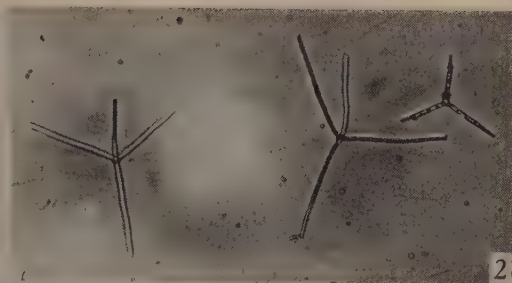
- Fig. 2. *Tetracladium setigerum*. Liberated spore. Of the four divergent arms only three can be seen; the other is completely out of focus. From the fungus growing on a submerged alder leaf. $\times 500$.
- Fig. 3. *Tetracladium Marchalianum* De Wild. Conidiophore bearing a mature spore, with its four divergent arms and two knobs, on the right, and a young developing spore which has not yet branched on the left. From pure culture. $\times 525$.
- Fig. 4. *Articulospora tetracladia* n.gen., n.sp. Conidiophore with three aleuriospores developing from its apex (marked with arrow). The central spore is nearly mature. That on the left is just developing its fourth arm. That on the right is young with only the first arm fully formed, and the second arm just beginning to develop at its end. Compare with Text-fig. 26, 11.15 p.m. From pure culture. $\times 315$.
- Fig. 5. *Articulospora tetracladia* n.gen., n.sp. Spores. From pure culture. $\times 173$.
- Fig. 6. *Heliscus longibrachiatus* n.sp. Conidiophore. The three fine arms of the phialospore have reached about half their final length. From alder leaves. $\times 525$.
- Fig. 7. *Heliscus longibrachiatus*. Spore. The third fine arm, pointing directly towards the observer, is entirely out of focus. $\times 525$.
- Fig. 8. *Tricladium splendens* n.gen., n.sp. Two conidiophores from pure culture. The conidium on the right-hand one is nearly mature. In each the arrow should indicate the junction between the spore and its conidiophore, but in the specimen on the left, the arrow indicates a position 2.5 mm. above the junction. $\times 320$.
- Fig. 9. *Tricladium splendens*. Three spores. Developed under conditions of pure culture. $\times 173$.

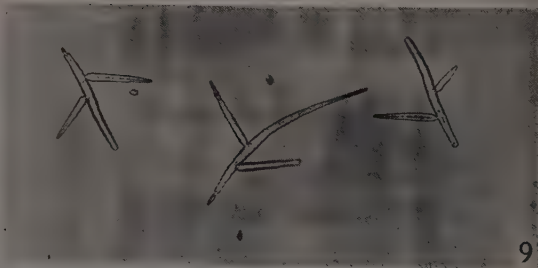
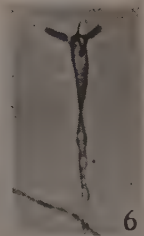
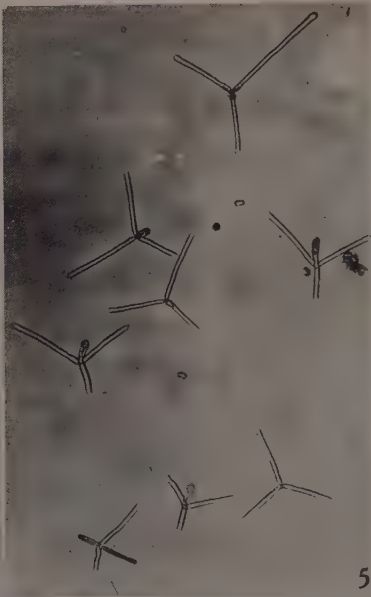
PLATE XIV

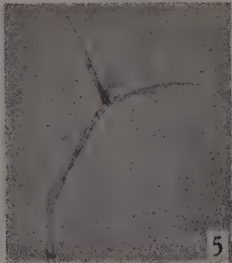
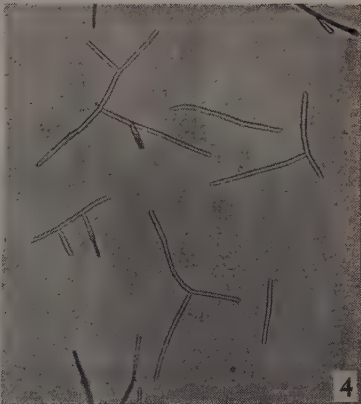
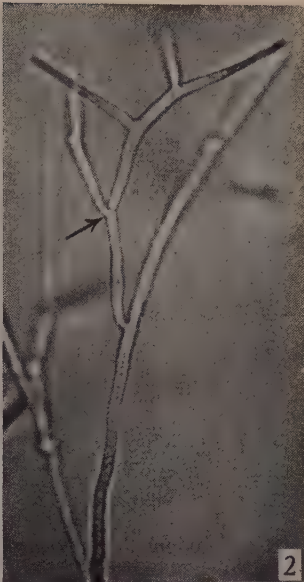
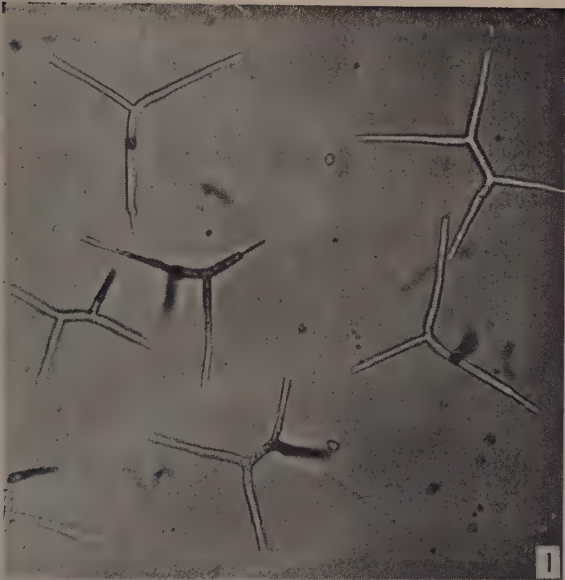
- Fig. 1. *Tricladium angulatum* n.sp. Spores from pure culture. $\times 325$.
- Fig. 2. *Tricladium angulatum*. Conidiophore from pure culture. From the tip (marked with an arrow) two spores are developing. That on the right is nearly mature. That on the left, which is somewhat out of focus, is young and consists of a main axis from the left-hand side of which the first lateral arm of the spore is just beginning to develop. From pure culture. $\times 480$.
- Fig. 3. *Varicosporium Elodeae* Kegel. Conidiophore from pure culture. The conidiophore is unbranched and bears three conidia, none of which is fully developed. One spore is apical, the second has arisen very near the first on the left-hand side of the conidiophore. Each of these spores consists of a main axis and one lateral branch. The third spore is lower down on the left-hand side and consists of a main axis and two laterals. $\times 325$.
- Fig. 4. *Varicosporium Elodeae*. Part of a spore accumulation developed in pure culture. $\times 173$.
- Fig. 5. *Alatospora acuminata* n.gen., n.sp. Nearly ripe conidium attached to its phialide. Only three arms of the spore are showing; the third, pointing directly towards the observer, is completely out of focus. From alder leaf. $\times 525$.

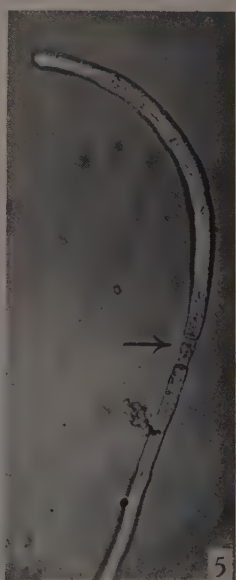
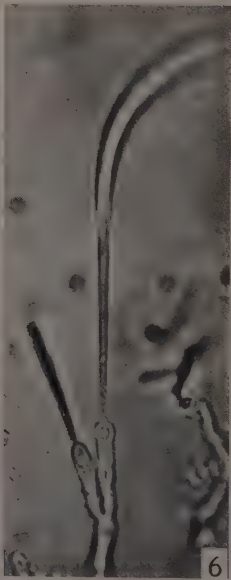
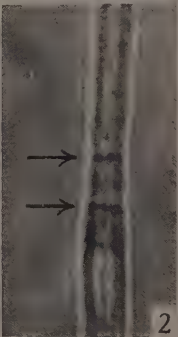
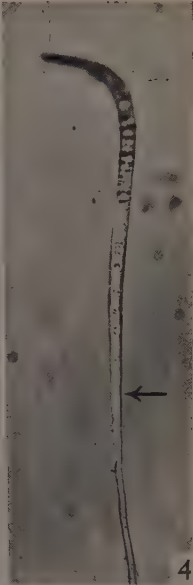
PLATE XV

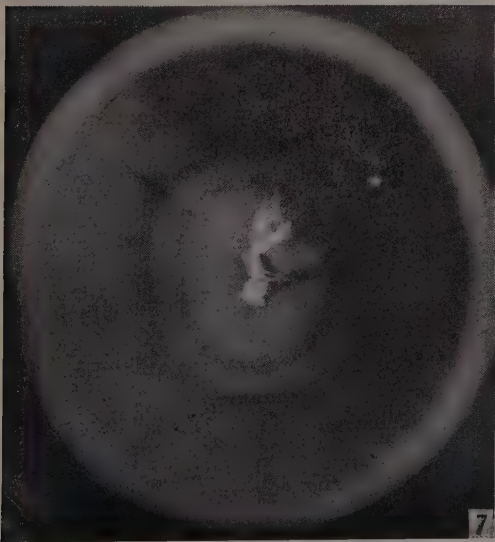
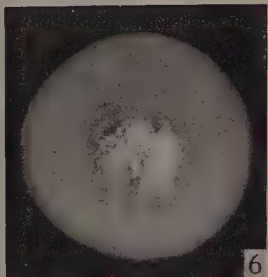
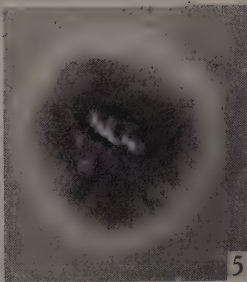
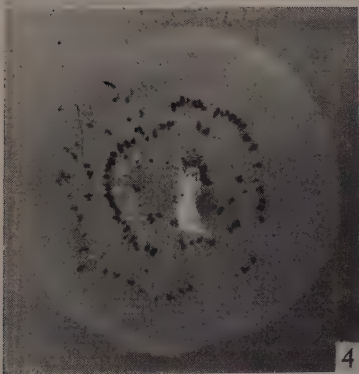
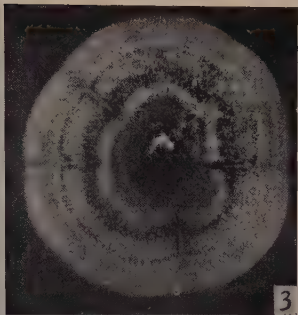
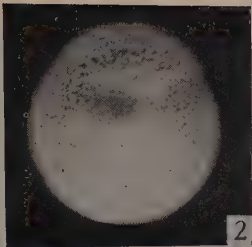
- Fig. 1. *Tetrachaetium elegans* n.gen., n.sp. Conidiophore with conidium. The separating cell is indicated by an arrow. From pure culture. $\times 338$.
- Fig. 2. *Tetrachaetium elegans*. The end of the conidiophore and the base of the spore; an enlargement of part of the previous photograph showing the separating cell, the limits of which are indicated by the two arrows. $\times 1290$.
- Fig. 3. *Tetrachaetium elegans*. A single spore. From pure culture. $\times 173$.
- Fig. 4. *Anguillospora longissima* (Sacc. & Syd.) n.comb. Conidiophore with conidium. The arrow indicates the probable point of junction of the aleuriospore and the conidiophore. From alder leaf. $\times 325$.
- Fig. 5. *Anguillospora longissima*. Conidiophore with conidium. The separating cell, indicated by the arrow, is breaking down. From pure culture. $\times 540$.











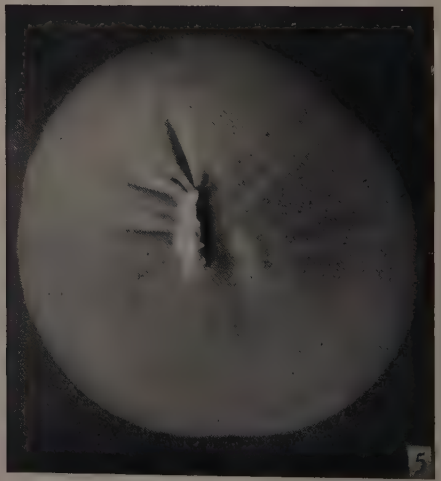
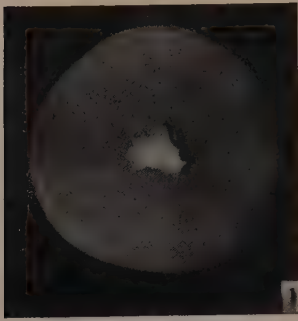


PLATE XV (continued)

Fig. 6. *Flagellospora curvula* n.gen., n.sp. A conidiophore consisting of two phialides. That on the left bears a young spore slightly out of focus. That on the right bears a nearly full-grown spore but only the basal region, where it joins the phialide, is in focus. From alder leaf. $\times 740$.

Fig. 7. *Lunulospora curvula* n.gen., n.sp. Simple conidiophore. The conidium on the right is nearly mature and is attached to the end of the conidiophore by a small stalk cell. On the left is a small straight outgrowth which is a spore-plus-stalk-cell primordium. From alder leaf. $\times 540$.

PLATE XVI

Cultures of alder-leaf fungi. All the colonies are 3 weeks old, grown on malt agar at approximately 18° C. Natural size.

Fig. 1. *Tricladium splendens*.

Fig. 2. *Tetrachaetum elegans*.

Fig. 3. *Lemonniera aquatica*.

Fig. 4. *Margaritispota aquatica*.

Fig. 5. *Clavariopsis aquatica*.

Fig. 6. *Tetracladium Marchalianum*.

Fig. 7. *Heliscus aquaticus*.

Fig. 8. *Articulospora tetracladia*.

PLATE XVII

Cultures of alder-leaf fungi. The colonies are 1 month old, grown on malt agar at approximately 18° C. Natural size.

Fig. 1. *Tricladium angulatum*.

Fig. 2. *Anguillospora longissima*.

Fig. 3. *Varicosporium Elodeae*.

Fig. 4. *Lunulospora curvula*.

Fig. 5. *Alatospora acuminata*.

(Accepted for publication 11 March 1942)

A *FUSARIUM* WILT OF RUNNER BEANS

By D. L. G. DAVIES, *Department of Agricultural Botany,
University College, Cardiff*

(With Plate XVIII and 2 Text-figures)

1. INTRODUCTION

A wilt disease of runner beans, *Phaseolus multiflorus*, apparently not recorded previously, was reported from Worcestershire by Ogilvie and Mulligan (1932). During 1933 the causative fungus, a *Fusarium*, was isolated by these authors and its cultural characteristics ascertained, but it was not found possible then to identify the fungus positively. Healthy plants were infected and the fungus re-isolated from them. The following account is of further experiments carried out by me from 1936 to 1938, and first reported in a thesis '*Fusarium* diseases of crops in the Bristol Province', presented to the University of Bristol for the Degree of Ph.D., 1938.

2. THE DISEASE

Runner beans are extensively cultivated on the lighter soils of the western part of the Vale of Evesham and westwards towards the river Severn. The Wilt Disease occurs mainly in the Severn Valley near Kempsey, and also at Pershore and Bretforton. The diseased plants are found either in well-defined patches or scattered throughout the fields.

The symptoms of the disease may appear first of all on the primary leaves, the margins of which become yellowish green. Finally, the whole leaf wilts and becomes dry and brittle. The margins of the later compound leaves roll inwards and the leaflets droop. These symptoms appear progressively on the younger leaves till finally the whole plant withers and dies (Pl. XVIII, fig. 2).

The stem of an affected plant cut longitudinally shows a dark brown discoloration of the vascular system, which is traceable into the youngest leaves and pods and into the main and lateral roots of severely wilted plants (Pl. XVIII, fig. 1).

Transverse and longitudinal sections through stems, roots and leaf petioles show the fungus to be confined to the xylem elements, though, in severely infected plants, the pith and cortical tissues are invaded. Unilateral infection is sometimes found. The discoloured vessels, tracheids and xylem parenchyma are well defined by the presence of a brownish gum-like substance which may completely fill the xylem elements. The separate occurrence of the discolouring substance and hyphae was shown when the discoloration was traced to

Pods in which no hyphae could be found; moreover, the hyphae could not be isolated from discoloured tissues in the pods.

3. THE FUNGUS

Portions of diseased stem were cut off and surface-sterilized in 1/1000 mercuric chloride or else by dipping the material in alcohol and flaming. The epidermis and cortex were pared off and thin slices of vascular tissue were transferred to plates of malt-extract agar or of ground rice. Monospore cultures of the fungus were obtained by the dilution method described by Sherbakoff (1915). Preliminary inoculation experiments proved the pathogenicity of the fungus, and for the purpose of identification the fungus was grown on malt-extract agar, wheatmeal agar, oatmeal agar, 2½ % potato-dextrose agar, rice grains and raw potato plugs.

The morphological (Text-fig. 1) and cultural characteristics of the fungus are as follows:

On malt-extract agar. Aerial mycelium abundant, Safrano-pink to pale flesh colour; sporodochia, salmon to flesh-ochre; substratum, violet-purple (Ridgway, 1912).

Measurements of spores from aerial mycelium:

0-septate:	8.0 × 2.3 μ	90 %	Range: 6.12 × 1.5-3.3 μ
3 "	35.5 × 3.27 μ	10 %	" 27.43 × 3.2-4.6 μ

Chlamydospores abundant in aerial mycelium, solitary, and in chains. Average diameter 8.6 μ.

On wheatmeal agar. Aerial mycelium scanty, white; plectenchyma, dark aniline blue.

Measurements of spores from pionnotes:

0-septate:	8.5 × 2.9 μ	80 %	Range: 6.12 × 2.3 μ
1 "	12.8 × 3.0 μ	3 %	" 10.5-15 × 2.5-5 μ
2 "	19.5 × 3.0 μ	1 %	" 18.0-24 × 2.9-3.0 μ
3 "	36.4 × 3.3 μ	15 %	" 19.0-42 × 2.5-4.5 μ
4 "	40.8 × 4.0 μ	1 %	" 39.0-42 × 4.0 μ

Chlamydospores from aerial mycelium, terminal, intercalary and in chains. Average diameter, 9.6 μ.

On oatmeal agar. Aerial mycelium abundant, white to flesh-pink to pale rose-purple; substratum, mauve to litho-purple.

Measurements of spores from pionnotes:

0-septate:	8.27 × 2.76 μ	60 %	Range: 6.12 × 2.5-3.0 μ
1 "	16.0 × 3.15 μ	1 %	" —
2 "	24.0 × 3.70 μ	1 %	" —
3 "	36.18 × 3.35 μ	33 %	" 27.42 × 3.4-5 μ
4 "	42.2 × 4.0 μ	4 %	" 39.48 × 4.5-0 μ
5 "	43.5 × 3.6 μ	Few	" —

On potato-dextrose agar. Aerial mycelium scanty; surface of medium covered with spores in pionnotes. Mycelium, pale flesh colour. Pionnotes, carrot-red.

Measurements of spores from pionnotes:

0-septate:	$9.7 \times 2.9 \mu$	12%	Range:	$6-15 \times 2.3 \mu$
1	" $14.7 \times 3.0 \mu$	3%	"	$12-18 \times 2.5-3.5 \mu$
2	" $23.0 \times 3.4 \mu$	1%	"	$15-28 \times 3.4 \mu$
3	" $36.1 \times 3.2 \mu$	83%	"	$30-45 \times 3.4 \mu$
4	" $41.6 \times 4.0 \mu$	1%	"	$39-43 \times 4.0 \mu$

On rice. Aerial mycelium very scanty. Rice grains covered with spores, shrimp-pink to orange-pink.

Measurements of spores from sporodochia:

0-septate:	$8.3 \times 2.8 \mu$	6%	Range:	$6-12 \times 2.5-3 \mu$
1	" $16.8 \times 3.0 \mu$	3%	"	$9-27 \times 3.0 \mu$
2	" $21.4 \times 3.0 \mu$	1%		—
3	" $36.0 \times 3.2 \mu$	80%	"	$22-42 \times 3.4 \mu$
4	" $42.3 \times 3.4 \mu$	10%	"	$36-48 \times 3.4 \mu$

The fungus has a marked odour when grown on rice.

On potato plugs. Aerial mycelium abundant, white to Safrano pink to greyish lavender.

Measurements of spores from aerial mycelium:

0-septate:	$7.4 \times 3.0 \mu$	70%	Range:	$5-12 \times 2.5-3 \mu$
1	" $15.8 \times 3.02 \mu$	3%	"	$12-21 \times 3.3-2 \mu$
2	" $23.6 \times 3.20 \mu$	3%	"	$18-27 \times 3.4 \mu$
3	" $31.8 \times 3.3 \mu$	4%	"	$27-42 \times 3.4 \mu$

Average of spore measurements on all media:

0-septate:	$8.5 \times 2.80 \mu$	56%	Range:	$5-12 \times 1.5-3.3 \mu$
1	" $15.3 \times 3.03 \mu$	2%	"	$10-27 \times 3.5 \mu$
2	" $22.2 \times 3.18 \mu$	2%	"	$18-27 \times 3.5 \mu$
3	" $35.3 \times 3.28 \mu$	38%	"	$19-44 \times 2.5-4.6 \mu$
4	" $42.0 \times 3.80 \mu$	2%	"	$39-48 \times 3.5 \mu$
5	" $45.0 \times 3.80 \mu$	Rare		—

Cultures were sent to Dr H. W. Wollenweber who kindly identified the fungus as *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw.

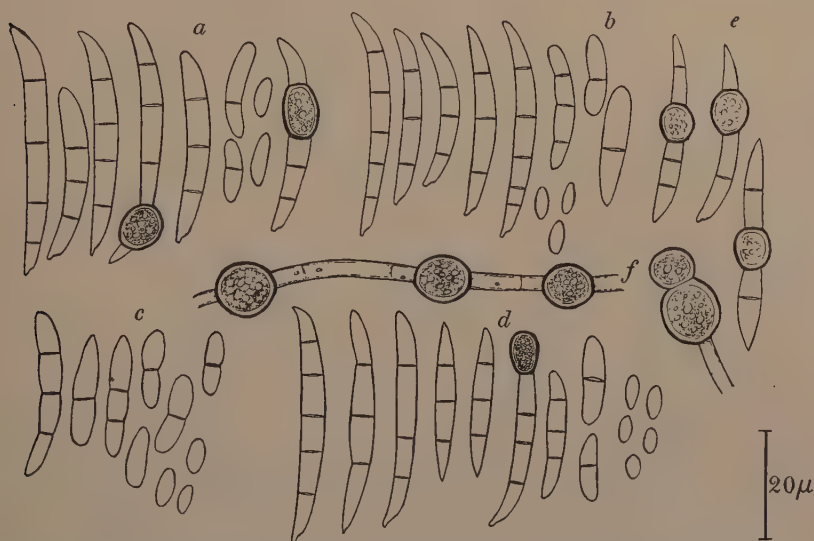
The following description of the fungus is given by Wollenweber and Reinking (1935):

Fusarium vasinfectum Atk. var. *lutulatum* (Sherb.) Wollenw.
Syn. *Fusarium lutulatum* Sherb.

'Distinguished from the type species by rather longer conidia and by the occasional appearance of numerous small blue-black sclerotial bodies up to 0.5 mm. in diameter. The conidia are three-septate, rarely four- and five-septate. The aerial mycelium bears numerous one- or two-celled microconidia. Conidia three-septate, $34 \times 3.8 \mu$; range, $28-42 \times 3.2-4.5 \mu$. Five-septate, $42 \times 4 \mu$; range, $37-47 \times 3.5-4.5 \mu$. Six- to seven-septate conidia (rare), $50-66 \times 3.5-5 \mu$. Chlamydo-spores terminal and intercalary, one-celled 7×6 ($6-8 \times 5-7$) μ . Two-celled, 10.3×5.4 ($8-12 \times 4-7$) μ . The fungus gives an aromatic odour.'

Fusarium vasinfectum var. *lutulatum* has a restricted host range; it has been reported by van Hall (1903) from wilted peas, associated with two other species of *Fusarium*, and by Wollenweber (private communication) as the cause of a wilt of *Lathyrus odoratus*. Wollenweber and Reinking (1935) also record its isolation from rotted material of onion, hyacinth, narcissus, China aster, sweet pea, banana and potato.

The effect of temperature upon the growth of the fungus in culture was determined by inoculating the centres of plates of malt-extract agar with spores and mycelium and incubating the plates in triplicate

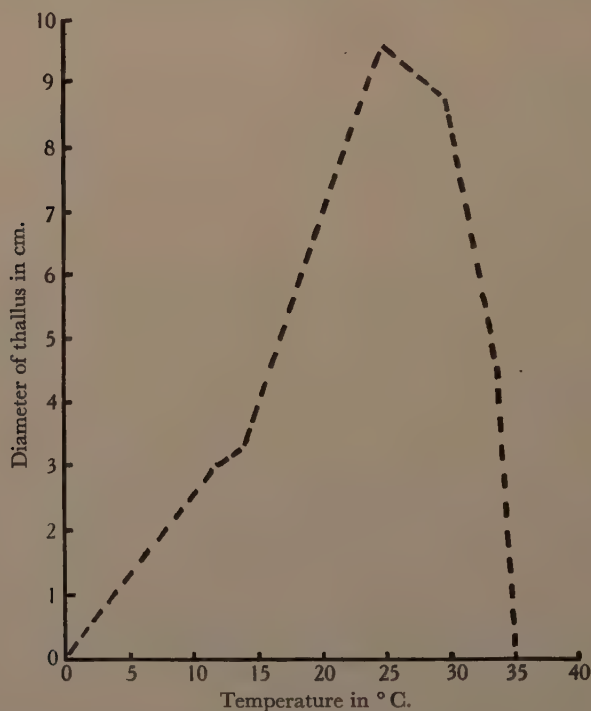


Text-fig. 1. *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw. (a) Conidia and conidial chlamydospores from pionnotes on potato-dextrose agar. (b) Conidia from rice grains. (c) Microconidia from oatmeal agar. (d) Conidia from wheatmeal agar. (e) Conidial chlamydospores from wheatmeal agar. (f) Terminal and intercalary chlamydospores from wheatmeal agar.

at various temperatures between 0° and 40° C. No growth was observed at 0° and 35° C. Growth increased gradually from 2° up to 28° C., the optimum temperature for growth, and then fell rapidly to 35° C. Spores placed in hanging drops of water in Van Tieghem cells were subjected to 15° of frost out of doors, but they germinated within five hours on being placed in an incubator at 28° C. Spores subjected to a moist heat of 40° C. for five hours germinated after a period of five hours at 28° C. The optimum temperature for spore germination is the same as that for growth, and at this temperature the spores germinate in five hours (Text-fig. 2).

4. INFECTION EXPERIMENTS

Infection experiments were carried out by Ogilvie and Mulligan (1933), and the following are confirmatory of their results. Four isolations of the fungus from different localities in Worcestershire were used throughout the following experiments. In order to infect the soil artificially the fungus was grown on sterilized bran incubated at 28° C. When the fungus was uniformly dispersed throughout the bran, the inoculum was mixed with sterilized soil in trays in the proportion



Text-fig. 2. Relation of temperature to the growth of *Fusarium vasinfectum* var. *lutulatum* on malt-extract agar, after seven days.

of one part of inoculum to nine parts of soil and kept in a greenhouse for from five to seven days. The infected soil was then rubbed through a fine mesh sieve and placed in sterile pots. For the controls, sterile bran was mixed with sterile soil in the same proportions.

Runner beans (var. Giantess Painted Lady) raised in artificially infected soil in the plantation of the Long Ashton Research Station, Bristol, developed wilt symptoms during July 1936, and on taking up these plants the foot of each was found to have been attacked by

slugs. It was thought that the fungus might have entered through these wounds, and experiments were thereupon conducted in which the bean plants were inoculated in the foot.

Bean plants raised in boxes were taken up when 6 in. high and the roots were washed free from soil, particular care being taken to damage the roots as little as possible during the operation. The plants were inoculated by slitting the cortical tissues of the foot and placing fungal mycelium or spores in contact with the vascular tissues. The plants were then placed in pairs in pots containing sterile soil and kept in a greenhouse or out of doors.

Experiment 1, 19 July 1936. Sixteen plants were treated in the manner described above and placed in pairs in 7 in. pots in the hot-house. Control plants were wounded in the foot and planted in sterile soil. On 11 August 1936 one plant showed the typical symptoms of the wilt disease and on splitting the stems of all the inoculated plants a vascular discoloration was observed, extending downwards into the roots and upwards to the leaves. The fungus was recovered and identified as *Fusarium vasinfectum* var. *lutulatum*. The control plants were perfectly healthy.

Experiment 2, April 1937. Forty plants were inoculated, ten to each fungus isolation, and planted out of doors in deep wooden boxes containing an unsterilized sandy loam. Forty plants were wounded in the foot and planted in a similar box; these served as controls. One plant wilted completely within three weeks of inoculation and two others collapsed after six weeks. The remaining inoculated plants became noticeably infected by the end of August. The general symptoms were identical with those of naturally infected plants; severe infection resulted in the pith and cortical tissues being attacked and decomposed with fructifications of the fungus appearing on the outside of the plants. Unilateral infection was common where the wound made was a single narrow slit which exposed a small area of vascular tissue. The control plants were normal and bore large pods.

Experiment 3, 19 July 1937. Twenty-four runner bean plants raised in wooden boxes were removed from the soil and divided into two lots of twelve. The roots of each plant were washed free of soil and the foot of one lot of plants was wounded and the plants placed separately in 12 in. pots containing infected soil. The remaining plants were unwounded and planted separately in pots containing infected soil. All pots were placed out of doors. Of the twelve wounded plants, four had completely wilted after six weeks and the remaining plants all displayed a vascular discoloration extending throughout the roots and upwards to the first pair of leaves. The unwounded plants became infected also, the whole set wilting completely after eight weeks.

It was concluded that the roots had been damaged in transplanting

and since the experiment was intended to test if the fungus could attack the plants through wounds, or would penetrate the plant tissues unaided, the methods used in this experiment were obviously unsatisfactory. It was therefore decided to sow bean seeds in infected soil so as to overcome the process of transplanting.

Experiment 4, 17 March 1938. Six 6 in. pots containing sterile soil were used in this experiment; the soil in three of the pots was infected with the fungus by the method described earlier in this paper. The three remaining pots contained sterile soil. All six pots were kept in a greenhouse for seven days, after which three surface-sterilized bean seeds were sown in each pot. All the seeds germinated and the plants grew normally for a few weeks. By 24 April 1938 two plants in one pot containing infected soil were in an advanced state of wilting. One other plant showed the first symptoms of attack, a yellowing of the primary leaves and a rolling of the margins of the secondary leaves which was followed by yellowing, wilting and shrivelling. On 30 April two more plants had begun to wilt, and by the first week in May all the plants in infected soil were diseased. The control plants in sterile soil were healthy (Pl. XVIII, fig. 2).

Each infected plant was carefully removed from the soil. Examination of the roots showed that no damage had been done by soil pests, but the emergence of secondary roots had caused marked splitting of the cortical tissues.

The experiment thus proved that the bean plant is attacked by the wilt organism in the absence of any damage by soil pests, but it is considered probable that a splitting of the cortical tissues of the foot region by the emergence of secondary roots facilitates the entry of the fungus into the vascular tissues of the plant.

Experiment 5. In order to investigate the possibility of *Fusarium vasinfectum* var. *lutulatum* entering the rooting system of the bean unaided, an experiment of the kind described by Tisdale (1917) was made.

Rolls of filter paper were placed in the bottom of boiling tubes and malt-extract agar was added. The tubes were then plugged with cotton-wool and sterilized. The filter papers were inoculated with the fungus and when they were completely overgrown by mycelium, one surface sterilized bean seed was placed on the top of each roll of paper.

The beans germinated and the plants developed normally for many weeks. Plants were taken from the tubes periodically and the roots and root hairs were examined microscopically. It was found that the roots were always closely invested with a mycelial sheath ending some distance below the foot. No penetration of the epidermal cells of the roots or root hairs by the fungus was observed. It is therefore considered probable that infection takes place primarily as a result of wounding of the foot or of the roots by soil pests and that the natural

mechanical splitting of the foot is also an important factor resulting in infection.

Experiment 6. Ordinary potting soil was artificially infected with the fungus and placed in six 8 in. pots. Three bean seeds were sown in each pot; three were placed in earthenware saucers filled with water and so kept very wet whilst the remaining pots were watered normally. Six control pots containing uninfected soil were divided into two lots of three, one lot kept wet, the other given a normal watering. The first signs of a vascular discoloration were noted on 6 July, and it was equally evident in both series of plants. All plants showed symptoms of wilting by 21 July, but no differences were observed between plants watered excessively and those given a normal watering.

Experiment 7. Runner beans were raised in boxes of unsterilized soil and when they had reached a height of 4 or 5 in. they were inoculated. Narrow slits were made in the stem at various points between the cotyledons and the primary leaves, the slits penetrating to the vascular tissues. Mycelium was inserted into the wounds, the wound covered by moist cotton-wool and bound by adhesive tape.

A number of these experiments were conducted in the greenhouse throughout the autumn and winter of 1935-6 and out of doors during the spring and summer of 1936, but no wilting occurred. The plants grew normally to maturity and bore well-developed pods. Apart from a light brown staining of the tissues at the point of inoculation, and the invasion of a few adjacent cells, the fungus had no effect upon the plants.

Cross-inoculation experiments carried out on dwarf beans (*Phaseolus vulgaris*), broad beans (*Vicia Faba*), sweet peas (*Lathyrus odoratus*), and garden peas (*Pisum sativum*), including stem inoculations, 'foot' inoculations and soil-infection experiments in the greenhouse and in the field, showed these plants to be resistant to the strain of *Fusarium vasinfectum* var. *lutulatum* under investigation.

5. RESISTANCE OF VARIETIES

A field trial carried out by Ogilvie and Mulligan (1933) revealed no variety immune from the disease. The following varieties, however, gave the best results on infected ground, in descending order of resistance: Giant Painted Lady, Czar, Sutton's Scarlet, Giantess Painted Lady and White Prize-Winner. Of these Giant Painted Lady was found to be outstanding.

SUMMARY

1. A wilt disease of the runner bean (*Phaseolus multiflorus*), caused by the fungus *Fusarium vasinfectum* Atk. var. *lutulatum* (Sherb.) Wollenw., is described.

2. The symptoms appear on mature plants as wilted and withered leaves with a dark brown discoloration of the vascular system.

3. *Fusarium vasinfectum* var. *lutulatum* develops in culture from 4 to 34° C. The optimum temperature for growth lies in the vicinity of 26° C.

4. Inoculations on wounded stems above the cotyledons did not induce wilting, but it was easily induced by inoculations of the bases of the plants and by sowing seeds in infected soil. Damage done to the rooting systems by soil pests renders the plant susceptible to attack, and natural splitting of the cortical tissues of the foot region enables the fungus to penetrate to the vascular system, to which the fungus attack is later restricted.

5. Waterlogging of the soil has no appreciable effect upon the severity of the disease.

6. Dwarf beans, broad beans, sweet peas and garden peas did not develop symptoms when inoculated with strains of *Fusarium vasinfectum* var. *lutulatum* isolated from runner beans.

I am indebted to the Long Ashton Research Station, Bristol, for facilities granted to me in connexion with the investigation. I am also indebted to Mr L. Ogilvie for his interest throughout the course of the work and for helpful criticism in the preparation of this paper. The photographs were taken by Mr G. H. Jones to whom the writer extends his sincere thanks; they are published by courtesy of the Long Ashton Research Station.

REFERENCES

- OGILVIE, L. & MULLIGAN, B. O. (1932). Progress report on vegetable diseases. *Ann. Rep. agr. and hort. Res. Stn, Long Ashton, Bristol*, p. 107.
 OGILVIE, L. & MULLIGAN, B. O. (1933). Progress report on vegetable diseases. *Ann. Rep. agr. and hort. Res. Stn, Long Ashton, Bristol*, p. 104.
 RIDGWAY, R. (1912). *Color Standards and Color Nomenclature*. Washington, D.C.
 SHERBAKOFF, C. D. (1915). *Fusaria of potatoes*. *Cornell Agr. Expt. Stn Memoir*, no. 6.
 TISDALE, W. M. (1917). Flax wilt. A study of the nature and inheritance of wilt resistance. *J. agr. Res.* xi, 573-606.
 VAN HALL, J. C. (1903). Die Sankt Johannis Krankheit der Erbsen verursacht von *Fusarium vasinfectum* Atk. *Ber. d. Deuts. Bot. Ges.* xxi, 2-5.
 WOLLENWEBER, H. W. & REINKING, O. A. (1935). *Die Fusarien*. Berlin: Paul Parey.

DESCRIPTION OF PLATE XVIII

Fig. 1. Right: stems of wilted bean plants showing an intense vascular discoloration. Left: stems of healthy plants.

Fig. 2. Runner bean plants raised from seed sown in inoculated and sterile soil. Right: plants in an advanced stage of wilting. The primary leaves turn yellow, and the margins of the secondary leaves curl. Left: healthy control plants.

(Accepted for publication 14 March 1942)



Fig. 1



Fig. 2

LIST OF HYPHOMYCETES RECORDED FOR BRITAIN. SUPPLEMENTARY NOTE

By E. M. WAKEFIELD AND G. R. BISBY

Some errors which missed correction before publication of the List (*Trans. Brit. myc. Soc.* xxv, 49-126, 1941) have been noted, as follows:

ERRATA

- p. 54: *Dendrodochium album* and *D. citrinum* are Coelomycetes; see Grove, 1 (ii, 131, 133).
 p. 75: *Monilia glasti* was on woad, not wood.
 p. 80, 8th line from bottom: for *Apionectria* read *Apiocrea*.
 p. 82: transfer *Symphyosira* to Phragmosporae, i.e. to p. 97.
 p. 98: *Alternaria Tomato*: insert 'y' after Cooke.

This opportunity is taken to add some records which have been made since publication of the list, and one, *Aspergillus restrictus*, which was omitted.

- Add to p. 53: **Cephalosporium Bertholletianum** Spencer. Dennis & Foister, 28 (xxv, 287, 1942). On Brazil nut, Scotland.
 Add to p. 68: **Aspergillus restrictus** G. Smith in 90 (*J. Textile Inst.* xxii, T 115, 1931). Causing mildew in cotton goods.
 Add to p. 79: **Penicillium Thomii** Maire: Add 28 (xxv, 206-208, 1941). On living leaves of *Cypripedium callosum*, Hertfordshire.
 Add to p. 85: **Didymopsis Helvellae** (Corda) Sacc. & March. 54 (xv, 197, 1941). On *Helvella*, Wheatfen Broad, Norfolk.
 Add to p. 89: **Cercospora Primulae** Allesch. 28 (xxv, 209, 1941), on *Primula juliae* hybrid; 28 (xxv, 295, 1942), recorded from Scotland. Probably a stage in life history of *Ramularia Primulae* Thuem.
 Add to p. 92: **Helminthosporium siccans** Drechsler. 28 (xxv, 274, 1942). On *Lolium*, Scotland.
Helminthosporium vagans Drechsler. 28 (xxv, 275, 1942). On *Poa* spp. Scotland.
 Add to p. 94: **Ramularia Cicutae** Karst. 54 (xv, 198, 1941). On *Cicuta virosa* L., Wheatfen Broad, Norfolk.
Ramularia deflectens Bres. 28 (xxv, 299, 1942). On cultivated *Viola* hybrids, Scotland.
Ramularia 'Epilobii-palustris' Allesch. 54 (xv, 198, 1941). On *Epilobium palustre* and *E. tetragonum*, Wheatfen Broad, Norfolk.
 Add to p. 96: **Septocylindrium aromaticum** Sacc. 54 (xv, 198, 1941). On *Acorus Calamus*, Wheatfen Broad, Norfolk.
 Add to p. 97: **Septocylindrium Ranunculi** Peck. 54 (xv, 198, 1941). On *Ranunculus repens*, Wheatfen Broad, Norfolk.
Alternaria radicina Meier, Drechsler & Eddy. 31 (cxi, 172, 1942); 28 (xxv, 282, 1942), Scottish record. Causing black rot of carrots in store.
 Add to p. 99: **Fumago salicina** (Pers. ex Fr.) Tul. 54 (xv, 197, 1941). On honeydew on *Salix* and *Malus*, Wheatfen Broad, Norfolk.

(Accepted for publication 31 July 1942)

DISCUSSION ON MYCOLOGICAL NOMENCLATURE, 21 FEBRUARY 1942

WHY RULES?

By E. M. WAKEFIELD

I. *Historical summary*

Before the time of Linnaeus, a botanist wishing to refer to any particular plant was obliged to use a descriptive phrase. If the plant was very distinct perhaps two words would be sufficient, but as more species became known the more complicated became the phrases necessary to describe them. Thus the common mushroom was for Bauhin (1596) 'Fungus campestris albus superne inferne rubens', while Micheli in 1729 distinguished various species and varieties of what we now call *Agaricus* as 'Fungus esculentus albus', 'Fungus esculentus magnus', 'Fungus esculentus nemorosus', etc., often with further descriptive words added. *Xylaria Hypoxylon* was for Ray (1690) 'Fungus ramosus, niger, compressus, parvus, apicibus albidis', so described to distinguish it from other branched fungi such as *Clavaria* spp.

Linnaeus's great service to all biology was the establishment of a system of binary nomenclature, whereby each plant and animal received a simple name consisting of two words only, one denoting the genus to which it belonged and the second the species. Further, Linnaeus used great care in the delimitation of generic and specific characters, and this with his system of classification gave an impetus to the study and description of plants and animals. Linnaeus himself knew very little of fungi, and his *Species Plantarum* includes the names of only ten genera. Following him, however, came local fungus floras and large illustrated works, as for instance Schaeffer, Müller in the *Flora Danica*, Bulliard in France, Willdenow, Link, Tode, and Schrader in Germany, in England, Bolton and Sowerby, and then C. H. Persoon, whose *Synopsis Methodica Fungorum* (1801) was the most important work on European fungi published up to that date. Later on came Albertini and Schweinitz, Nees von Esenbeck, and then Elias Fries, whose *Systema Mycologicum* (1821-32) is to the mycologist what Linnaeus's *Species Plantarum* is to the phanerogamist.

All these works naturally dealt chiefly with European species, but even at the end of the seventeenth century fungi had begun to trickle in from overseas. Fries received many species, and, with improved facilities for classification and identification, collectors were encouraged, and presently we have M. J. Berkeley, Montagne and others describing hundreds of new species and genera received from all over the world.

As long as the number of books and of described species remained relatively few, it was an easy matter to decide whether any plant received had been previously described or not. With increased botanical activity, however, difficulties of identification necessarily arose, since with the lesser bibliographical facilities of those days it became difficult for any one worker to be sure that he had seen all the relevant literature. The need for a complete index of all described species of plants was early recognized by phanerogamists, and was met first by Steudel's *Nomenclator Botanicus*, published in 1821, and followed in 1824 by a companion volume dealing with cryptogamic plants. Names of fungi were included in Pfeiffer's *Nomenclator Botanicus* (1873-4), which compiled names published up to the end of 1858. The first complete index to fungus names only was Streinz, *Nomenclature des Champignons*, 1863, which enumerated less than 12,000 species. The first eight volumes of Saccardo's *Sylloge*, published between 1881 and 1889, compiled nearly 32,000 names.

The compilation of these indexes revealed that confusion already existed in the use of names. Sometimes a name given to a fungus had already been used for a plant belonging to some other group, as for example *Crouania* Fuck. (1869), a duplicating name or *homonym* of *Crouania* Ag. (1842), a genus of Algae. Saccardo recognized this and changed the name to *Barlaea* Sacc. (1889), but in so doing fell into a similar mistake, since there was already a *Barlaea* Reichenb. among the Orchidaceae. Similarly *Lachnea* Gill. (1879) duplicated

Lachnaea Linn. (1763), a genus of Thymelaeaceae, *Kneiffia* Fr. (1838) was antedated by *Kneiffia* Spach (1835); *Sphaerella* Ces. & De Not. was a later homonym of *Sphaerella* Sommerf. in the Algae, and *Marssonina* Fisch. (1874) a homonym of *Marssonina* Karst., belonging to the Gesneriaceae. There are numerous examples of such homonyms in different groups, but sometimes also names of fungi were duplicated; for instance *Barclayella* Sacc., a genus in Melanconiaceae, was found to be antedated by *Barclayella* Diet. in the Uredinales; Saccardo therefore later altered the name of his genus to *Neobarclaya*.

With the abundance of material then coming in, and the development of the microscope, mycologists began in the first half of the nineteenth century to do more than just name and list fungi. Critical work resulted in monographs dealing with single genera or groups of genera, and reviewing all the previous literature. Such work often led to two discoveries, (1) that species had been described under genera to which they did not belong, according to modern ideas, and would have to be transferred, or (2) that the same plant had been described more than once under quite different names. Thus synonyms were recognized.

Again, names of both genera and species had sometimes been changed because the author who did so objected to the form or the spelling of the original name. Saccardo changed *Cellulospodium* Peck to *Cytosporium* because *Cellulospodium* is made up of a Latin and a Greek word; he changed *Ostreichmion* Duby to *Ostreion*: *Pestalotia* De Not. (1839) was changed to *Pestalozzia* by Corda (1842), *Papulaspora* Preuss had become *Papulospora*, and so on. Some of the most flagrant cases of arbitrary changes are to be found in Clements, *Genera of Fungi*, and the second edition by Clements and Shear, as for instance *Chaetosira* Clem. instead of the valid *Wiesneriomyces* Koord., *Helicobasis* for *Helicobasidium*, and many other similar abbreviations of long names.

The confusion existing in regard to the use of names of phanerogams led Alphonse de Candolle in 1867 to formulate a set of rules, or 'Lois', to be observed in botanical nomenclature, and it is a remarkable testimony to De Candolle's grasp of essentials that these Laws have remained the basis of all codes proposed up to the present time. The first article stated that 'Natural History can make no progress without a regular system of nomenclature, acknowledged and used by a large majority of naturalists in all countries'. This, with some modification, remains the first article of the Rules of botanical nomenclature which we use to-day.

In 1867, as now, there were divergent opinions, and unfortunately De Candolle's Laws were not universally accepted. For instance, while some maintained that the correct name of a species should include the first specific epithet given to it, no matter under what genus, there were others (among them the first compilers of the *Index Kewensis*) who considered that the first name given in the accepted genus should be that to be maintained. The natural corollary of this second view was that the epithet of a species might be changed whenever taxonomic study necessitated its removal to another genus.

Between 1891 and 1898 Otto Kuntze published in three volumes a work entitled *Revisio Generum Plantarum*, in which with Teutonic thoroughness he examined existing generic names of both phanerogams and cryptogams, and showed how often botanists had neglected earlier names when describing new genera. Starting with the first edition of Linnaeus, *Systema Naturae* (1835), Kuntze applied rigidly the principle of priority laid down in the Laws, and by so doing found it necessary to change the names of over 30,000 species, with a correspondingly large number of genera. Of these genera over 200 were names of fungi. Kuntze's views on priority were largely ignored in Europe, but received wide acceptance in the United States. One reason for this was probably the fact that strict adherence to priority did not involve so many changes in the names of American plants as it did in the much longer known plants of the Old World. The work of Kuntze had this beneficial result, that it roused botanists to consider the need for Rules which would ensure the greatest amount of stability in nomenclature.

At a Botanical Congress held in Vienna in 1905 an attempt was made to obtain international agreement by detailed discussion of proposals for Rules. The results were incorporated in the *International Rules of Botanical Nomenclature*, published in 1906. There was, however, opposition especially on two points, namely the compulsory use of Latin for descriptions of new groups, and the provision for exceptions to the rule of priority for genera. These articles were unacceptable especially to some United States botanists, with the result that in 1907 the American Code of Botanical Nomenclature came into being. This Code insisted on rigid priority for all groups, starting from Linnaeus's *Species Plantarum* (1st ed. 1753), and also allowed descriptions in any language. For the next

twenty-five years the use of these two different sets of Rules was responsible for many differences in plant names as between the two sides of the Atlantic. For instance, Murrill adopted the specific epithet *pseudoboletus* of Jacquin, for what we call *Ganoderma lucidum*, and revived certain old generic names such as *Gymnopus* Roussel (1806).

Meanwhile in 1910 a third International Congress held at Brussels considered some amendments and additions to the International Rules, notably as regards the nomenclature of Cryptogams. The date 1753, which was the starting-point fixed for Phanerogams and Ferns, was considered too early for the Fungi, and at Brussels two works were decided on, namely Persoon's *Synopsis Fungorum* (1801), for the Rusts, Smuts and Gasteromycetes, and Fries's *Systema Mycologicum*, published in three volumes between 1821 and 1832, for the rest of the Fungi. Myxomycetes and Lichens were treated separately, and both these groups start from Linnaeus, 1753. To avoid disadvantageous changes which might result from strict application of the rule of priority, provision was made in 1905, and has been maintained in all subsequent editions of the Rules, for a list of generic names which would be treated as exceptions, *Nomina generica conservanda*.

Fortunately, by means of full discussion and some compromise agreement between the opposing schools of thought was at last reached at the International Botanical Congress held at Cambridge in 1930, and various details were threshed out at the succeeding Congress at Amsterdam, in 1935. Some points, however, still remain to be decided.

II. The present Rules

The International Rules as they stand may appear very complicated, but this is inevitable owing to the necessity of clearing up the confusion caused by non-observance of Rules in the past. Briefly, the provisions of our Rules may be classified as follows:

A. Principles

Articles 1-18 lay down general considerations and guiding principles, such as the necessity for Rules which all can understand, stability in nomenclature, the principle of priority in the use of names, the type method for determining the use of names, and the construction of names preferably from Latin and Greek. Also the various categories of taxonomic groups—Division, Class, Order, Family, and so on down to varieties and forms—are defined.

B. Rules

The remaining Articles, 19-74, consist of Rules, together with some additional Recommendations dealing with subsidiary points. The Rules concern:

(1) *Limitation of priority by fixing definite starting-points for each group.* As already mentioned those for the Fungi are Persoon's *Synopsis* (1801) for Rusts, Smuts and Gasteromycetes, and Fries's *Systema* (1821-32) for the remaining groups. In addition, Art. 21 provides for exceptions to the Rules, by the conservation of generic names which have come into general use, but which are not really legitimate. Such names may be proposed for conservation by anyone giving due notice to the Committee for Nomenclature at an International Botanical Congress, but they are not established until after they have been examined carefully as to their value and implications by a committee of competent authorities appointed for the group in question, and then passed by a general vote at the next Congress after recommendation by such a Committee. Pending the decision of Congress, however, botanists are authorized to use such names as have been proposed for conservation if they wish to do so. In accordance with this rule, long lists of conserved names of *Phanerogams* have been passed and are published as Appendices to the Rules.

For the *Fungi*, proposals for conserved names have been in existence since 1910, when Saccardo submitted a list to the Brussels Congress, but unfortunately too late for consideration by the mycological committee then in being. The first collected list of proposals was published in connexion with the 1930 Congress. Apparently a great many of these proposals were made simply in opposition to what Otto Kuntze had done, and a cursory examination is enough to show that not all of them are sound, and some in fact are unnecessary. Yet nothing has yet been done by the International Mycological Committee in the matter of examining these proposals and accepting or rejecting them. Because of this crying need the Nomenclature Committee appointed by the British Mycological Society in 1939 made a start with the task; three contributions have been published, and the results circulated to members of the International Committee. Unfortunately, the difficulties of war-time conditions have temporarily put an end to this work.

Another Article which affects priority is Art. 57, which states that in fungi with a pleomorphic life-cycle the correct name is the earliest which has been given to the *perfect* stage, provided that it is otherwise in accordance with the Rules. Ascomycetes and Basidiomycetes are specifically mentioned, but the Phycomycetes are not. There is some doubt whether the Rule can be applied to the Phycomycetes.

(2) *The methods of designating the various categories of taxonomic groups*, e.g. the termination *-ales* for Orders, *-aceae* for Families and so on. Also rules and recommendations are given for the formation of generic and specific names.

(3) *Conditions of valid publication of a name*. It must be (a) effective, that is, printed or indelible matter which is on sale to the public or distributed to representative institutions, and (b) it must be accompanied by a description giving the diagnostic characters; after 1 January 1935 this description must be in Latin.

Examples: Numerous new generic names were published in a paper on the classification of Fungi Imperfecti by von Höhnelt, which was printed after his death. No descriptions of these new genera were given and they can seldom be identified from the key characters. Such names are called *nomina nuda* and are not valid. Unfortunately *nomina nuda* are often perpetrated when collectors publish lists containing new names which have been given them in manuscript by specialists, but have not yet been described by those specialists. One cannot too strongly emphasize that names should not thus be published without the permission of their author, for even specialists have been known to change their minds.

(4) *Citation of authors' names for purposes of precision*. This is a necessary consequence of the type method of determining the application of names. The name of the author who first describes a new group is attached to its name, and if the position of the group is changed, then the name of the first author must be cited in brackets and the name of the author who makes the change added outside the brackets.

(5) *Names which are to be retained when groups are remodelled, divided, united, or transferred to other groups, with or without change of rank*. I would ask you to note here a point which is not always appreciated, namely that nomenclature must follow taxonomy. Changes of name may be due to two reasons: one is increase of knowledge about the plants themselves, resulting in changed views about the circumscription of groups, and the other is the consequences of the Rules themselves, as when earlier synonyms or homonyms are detected.

(6) *Names to be rejected, or illegitimate names*. These include *later homonyms* (already mentioned), names which have been used in different senses and have thus become a permanent source of confusion (*nomina ambigua*), as for instance *Hypochnus* (see *Trans. Brit. myc. Soc.* xxiii, 224), *Hypospila* (*Trans. Brit. myc. Soc.* xxiv, 284-5), names whose application is uncertain (*nomina dubia*), e.g. *Aldridgea* Mass.; names of groups whose characters were derived from discordant elements (*nomina confusa*), e.g. *Hypolyssus* Pers., described from an Agaric attacked by a *Hypomyces*, and *Heterobasidium* Mass., a resupinate Basidiomycete (? *Stereum*) on which a Pyrenomycete was growing; and groups based on monstrosities, e.g. *Mycodendron* Mass., *Bresadolina* Speg., *Myriadoporus* Peck.

(7) *Orthography of names*. The original spelling of names must be retained except when there is a typographic error or an obviously unintentional orthographic error. Consequently Guba was correct in reinstating the generic name *Pestalotia* in place of the spelling *Pestalozzia*. The latter could only be retained by getting it placed on a list of conserved names.

(8) *The type method of applying names*. This is recognized as a principle (Art. 18), and in the rule as to conservation of generic names it is stated that the application of a conserved name is decided by its type. Again there is a recommendation that authors publishing names of new groups should indicate what is their nomenclatural type (not necessarily the most typical form), i.e. type specimen for a new species, and type species for a genus. Thus each name becomes permanently associated with a particular type or standard.

These then are the main provisions of our Rules in outline. There are numerous points of detail dealt with, in particular as to the various complications which may arise when a species or a variety is transferred from one genus to another, or changed in rank. It is necessary to consult the Rules themselves in all cases of difficulty.

As an example of the working of the Rules, take the following names applied to species of *Gloeosporium* which cause anthracnoses, especially on fruits:

Septoria rufomaculans Berk. (1854), on grape.

Gloeosporium fructigenum Berk. (1856), on apple.

Gloeosporium laeticolor Berk. (1859), on peaches and nectarines.

- Ascochyta rufomaculans* (Berk.) Berk. (1860) (transference of *Septoria*).
Gloeosporium versicolor Berk. & Curt. (1874), on apple.
Gloeosporium rufomaculans (Berk.) Thuem. (1879) (transference of *Septoria*).
Gloeosporium piperatum Ell. & Ev. (1889), on *Capsicum*.
Colletotrichum nigrum Ell. & Halst. (1890), on *Capsicum*.
Gloeosporium cingulatum Atk. (1892), on privet.
Also numerous other spp. of *Gloeosporium* and *Colletotrichum*—e.g. on cacao, tea, etc.
Gnomoniopsis Stoneman, 1898 (a later homonym of *Gnomoniopsis* Berl.).
Gnomoniopsis cingulata Stonem. (1898), on privet.
Gnomoniopsis piperata Stonem. (1898), on *Capsicum*.
Gnomoniopsis fructigena Clinton (1902), on apple.
Glomerella Spauld. & v. Schrenk (1903) (to replace *Gnomoniopsis* Stonem.).
Glomerella rufomaculans (Stonem.) Spauld. & v. Schr. (1903), on apple.
Glomerella cingulata (Stonem.) Spauld. & v. Schr. (1903).
Glomerella fructigena (Clint.) Sacc. (1905).

If all these are one and the same species, the correct name is *Glomerella cingulata* (Stonem.) Spauld. & v. Schr. (1903), a change of *Gnomoniopsis cingulata* Stonem., the first name applied to the perfect stage.

If, however, the fungus causing Bitter Rot of apple is not the same as all these other species of *Gloeosporium*, etc. then its correct name is *Glomerella fructigena* (Clint.) Sacc.

If the rule were to take the earliest name for any stage, there would be less stability, for there would always be the possibility of a still earlier specific epithet than *rufomaculans* being detected.

In conclusion I will indicate points on which mycologists should make up their minds before any further revision of the Rules is undertaken. Some proposals were brought before the last Congress at Amsterdam in 1935, but decision on all of them was postponed until they could be examined thoroughly as to consequences. These were:

(1) To start the nomenclature of the Uredinales from Linnaeus, *Species Plantarum*, 1753.

This would give yet another starting-point for fungi, and should be perhaps considered in connexion with an old proposal to start all groups from Linnaeus. The latter is not very practicable.

(2) To regard the first date, 1821, of Fries's *Systema* as the starting-point for all groups of fungi other than those which begin from Persoon. The alternative is to start each group from the date when it was dealt with in the *Systema*, as for instance Discomycetes and Tremellaceae 1822, Hyphomycetes 1832. This latter practice is what is usually followed.

(3) To recognize the Friesian subgenera of *Agaricus* as genera.

This has been done in effect in many works, notably by Saccardo and by Rea, because if one does not, it is sometimes very difficult to find out who first made the combination for any particular species. The suggestion is however quite contrary to the Rules, and its opponents regard it as slipshod.

Further, we must complete the examination of all names which have been proposed for conservation, and also submit cases for any other generic names we wish so to retain. At the same time we should very carefully typify such genera, selecting, where no type was originally specified, a species which will conserve the sense in which the genus is now accepted. The rules for the selection of types which were promised as an appendix to the International Rules have not yet been formulated, but much can be done by study of the rules observed in the American Code, and by the application of common sense. The intention of the Rules is to bring stability into nomenclature, not to make needless changes by pedantic adherence to the letter rather than the spirit.

NEW SPECIES AND OLD

By E. W. MASON

The recently introduced type method of applying names, incorporated into the International Rules in 1930, sharply differentiates for us the two kinds of synonyms that may be termed the obligate and the facultative. My first example is taken from Seaver and Chardon (1926):

obligate	{	'Pucciniopsis Caricae (Speg.) Seaver (1926) syn. Cercospora Caricae Speg. (1886) Pucciniopsis Caricae Earle (1902)'	}	} facultative synonyms
synonyms				

The names '*Pucciniopsis Caricae* (Speg.) Seaver' and *Cercospora Caricae* Speg. have the same type specimen, broadly speaking the material from which Spegazzini in 1886 drew up his original description. That is what '(Speg.)' now signifies. They are accordingly alternative names for exactly the same species; and so obligate synonyms because their synonymy is not a matter of opinion, but of definition. *Pucciniopsis Caricae* Earle, on the other hand, has a different type specimen, the material from which Earle in 1902 drew up his description. Its synonymy with the other two names is a matter of judgment or opinion, and so can never be accepted outright, but accepted only with this proviso: without prejudice to further evidence. This name should accordingly be discriminated as only a facultative synonym of the other two.

Further, when Earle in 1902 validly published the binomial *Pucciniopsis Caricae*, he pre-empted the specific name *Caricae* in the genus *Pucciniopsis* for the species based on his own material. '*Pucciniopsis Caricae* (Speg.) Seaver (1926)' is accordingly illegitimate, as a later homonym of *Pucciniopsis Caricae* Earle (1902). These two names then are homonyms, i.e. they are the same name based on two different types; they are also facultative synonyms, i.e. names that have been held to refer to the same taxonomic species. Before the introduction of the type method, they could also perhaps have been held to bear yet a third relationship, i.e. to be in fact the same name for the same thing. For, then, the author of a species was held to have delimited it with his diagnosis, so that his species could be envisaged as consisting of all the specimens which answered to his description. Then the limits imposed by Earle's description, and the limits imposed by Spegazzini's description emended by Seaver, might well be identical, and the two species be the same not only in name but in everything else also. But now that an author's species is to be envisaged as consisting of all the specimens that can properly be grouped about his type specimen, species based on distinct type specimens must, in nomenclature, themselves be held distinct.

In my other two examples, the authors of Saccardo's *Sylloge* have raised the same issue, but confused it by attributing to Patouillard and to W. G. Smith respectively specific transfers that they never made.

Saccardo (1888) cited a name as '*Helicobasidium purpureum* (Tul.) Pat.'; on referring to the literature cited, however, the facts appear as follows. In 1865, *Hypochnus purpureus* Tul. was proposed as new, and in 1885 *Helicobasidium purpureum* Pat., also as new. Each then is based on its own type specimen; and the two names can never be more than facultative synonyms. Saccardo's false citation '*Helicobasidium purpureum* (Tul.) Pat.' accordingly is not only illegitimate as a later homonym, but also has two uncompromisingly distinct type specimens, and that is absurd. But another point arises here, for the type of a generic name is a species. Now *Helicobasidium purpureum* Pat. is the type species of the genus *Helicobasidium* Pat. (1885), and *Hypochnus purpureus* Tul. was transferred in 1887 to become the type species of *Stylinella* Schroet. Again, then, these generic names can be no more than facultative synonyms, and never obligate synonyms, as they would have been, had Saccardo's false citation been correct.

In these first two examples, no one has yet suggested that this nice nomenclatural distinction makes any great difference; in my third example, however, it might well have been invoked, and might have then perhaps made all the difference. De Toni (1888) cited a name as '*Urocystis Gladioli* (Requien) W. G. Smith'. The literature he cited, however, shows that W. G. Smith proposed *Urocystis Gladioli* W. G. Smith as new, and

had nothing at all to say about the prior *Uredo Gladioli* Requien ex Duby. De Toni's incorrect citation of '*Urocystis Gladioli* (Requien) W. G. Smith' was in time taken up by British mycologists, among others, and has been incorporated into the List of Common Names of British Plant Diseases. The succession of consequences of this false citation is still incomplete.

Dodge and Laskaris (1941), however, fully described a Hyphomycete on *Gladiolus* in U.S.A.; and although they suggested that their fungus was more likely to represent Smith's species than Requien's, they called it *Papulaspora Gladioli* (Requien) Dodge and Laskaris. The immediate point of general application that I desire to make, and I do not think that it has been taken before, is this. Assuming that they desired to use the binary name *Papulaspora Gladioli*, they had three choices open to them: (i) to risk transferring *Uredo Gladioli* Requien to *Papulaspora* and so accept Requien's type as their type: that is what they did; (ii) transfer *Urocystis Gladioli* W. G. Smith, and so accept Smith's type as their type; or (iii) scotch both these equivocal species inside the genus *Papulaspora* by proposing *Papulaspora Gladioli* as new, with their own indubitably *Papulaspora* material as its type specimen. Let us assume the third, and that either Requien's or Smith's species had later proved the same as this hypothetical new species. Then no harm could have resulted; then either or both, as the facts emerged, could have been listed as its facultative synonyms. But now that the only legitimate *Papulaspora Gladioli* has been published as an obligate synonym of *Uredo Gladioli* Requien, what if the latter after all should still prove a *Urocystis*? That indeed would be a pity.

REFERENCES

- DE TONI, G. B. (1888). Ustilagineae et Uredineae. In Saccardo, *Sylloge Fungorum*, vii, ii.
 DODGE, B. O. & LASKARIS, T. (1941). *Papulaspora Gladioli*. Bull. Torrey bot. Cl. LXVIII, 289-94.
 SACCARDO, P. A. (1888). *Sylloge Fungorum*, vi.
 SEAVER, F. J. & CHARDON, C. E. (1926). *Scientific Survey of Porto Rico and the Virgin Islands*, viii, part 1, Mycology.

WHO IS THE AUTHOR?

By G. R. BISBY

Most mycologists accept the citations and abbreviations of authors from any handy source. No doubt the name of the author is of less importance than that of the fungus; nevertheless, the International Rules of Botanical Nomenclature, under which good mycologists labour, give us advice which we should try to follow—or to improve. Botanists require, when necessary, the double citation of authors, though zoologists cite only the first author of a name.

I. Articles 46-9: *It is necessary to cite author or authors*; Art. 20: *Legitimate nomenclature of Uredinales, Ustilaginales, and Gasteromycetes begins with Persoon* (1801); *of Fungi caeteri with Fries* (1821-32).

Thus, for example, *Ustilago* (Pers.) Roussel (Persoon, 1801, had *Ustilago* as a subgenus of *Uredo*); *Puccinia graminis* Pers. [1794] 1801; *Lycoperdon* Pers. or, 'if useful or desirable' *Lycoperdon* [Tourn. 1700, p.p.; Mich. 1729] Pers., or *Lycoperdon* Mich. ex Pers.; *Gaeastrum* Pers. (syn. *Geaster* Mich. ex Fr.); *Botrytis cinerea* Fr. (or Pers. ex Fr., but not *B. cinerea* Pers.); *Cladosporium herbarum* Fr. is obviously usually more 'useful and desirable' than *C. herbarum* [(Pers.)] Link ex Fr.; *Amanita muscaria* (L. ex Fr.) S. F. Gray or, in my view much better, *A. muscaria* Fr. unless and until Congress may reject a proposal now before it that Fries's subgenera of Agaricaceae be treated as genera; *Hysterium* Fr. or, for formal purposes, *Hysterium* [Tode] Fr. em. Sacc.

A name not accepted by Persoon (1801) or Fries (*Systema*) is taken to be validated by its first subsequent use by these or other authors. Thus *Alternaria tenuis* Nees (1817) ex Wallr. (1833) would be an example, were it not for the fact that this common usage amounts to the conservation of a specific name, which is illegitimate. Fries accepted the species *A. tenuis*, but considered it a *Torula* and renamed it *T. alternata*, evidently because

there was already a *T. tenera*. So, as Mason noted fourteen years ago, *alternata* is the correct specific epithet, though the combination has apparently not yet been made. There is much to be said for the conservation of a few common and important specific names. Of course the same effect can sometimes be achieved, as with *Alternaria tenuis*, by letting the sleeping dog lie; furthermore, as is well known, one cannot make every mycologist drop a familiar name just because it is illegitimate.

II. Art. 57: *A fungus (Ascomycetes and Basidiomycetes mentioned) with pleomorphic life-cycle can bear only one binary name, the earliest valid name applied to the perfect form.*

Thus, for example, *Cymadothea Trifolii* Wolf, not (Pers. ex Fr.) Wolf, for Persoon's *Sphaeria* was pycnidial; *Sclerotinia Gladioli* Drayt., and so on. However, Article 57 needs rewording, for it is obvious that mycologists frequently should and must continue to use names of Fungi Imperfecti. *Cladosporium herbarum* is now technically illegal; its name should be *Sphaerella Tulasnei* Janczewski, 1893, stat. conid.

C. album Dowson (i.e. *Hyalodendron album*) has been reported to have *Erostrothea multi-formis* as its perfect stage; but I believe it would be better not to use the latter name in Britain until the connexion has been verified, the status of *Erostrothea* settled, and this stage found here.

As for the application of Rule 57 to Phycomycetes, I am convinced that it should not be attempted and is against the spirit of the Rules. The imperfect state of a Phycomycete is generally the more diagnostic and conspicuous. The following are a few possible examples of trying to apply Rule 57:

Phytophthora infestans [W. G. Smith??] Smorawski? (imperfect state *P. infestans* (Mont.) de Bary); *Pilobolus crystallinus* [Zopf??] Krafczyk?; *Peronospora Schachtii* Prill. (heretofore attributed in error to Fuckel); *P. sp.* (name and author indet.; syn. the invalid *P. parasitica* (Pers. ex Fr.) Tul.); *Rhizopus nigricans* de Bary (if de Bary first described zygospores), syn. *R. stolonifer* (Ehrenb. ex Fr.) Lind—and so on to little purpose; much work needed for hundreds of names, with no certainty that they would be right.

Since the International Rules aim at fixity of names and avoidance of confusion (Art. 4), it seems to me that Article 57 should not apply to Phycomycetes; also that the subgeneric names of Agarics in the *Systema* should be considered as generic; and that a very few specific names in constant use should be conserved.

Finally, who is the author of a name such as *Pseudonectria Rousseliana*? The genus *Pseudonectria* Seaver was described with 'Type species: *Nectria Rousseliana* Montag.' According to the letter of the law, the first writer who made, intentionally or unintentionally, the combination *P. Rousseliana* is the authority for the transfer; but since his publication may be difficult or impossible to find with certainty, I favour following the spirit of the Rules and citing the authorities as '(Mont.) Seaver'. In my view, conservatism should be used in nomenclature as well as in taxonomy.

After speaking on 21 February, I sent proposals about as follows to *Phytopathology*:

'1. That the conservation of specific names of Fungi be legalized. This should apply only to a few names that can be shown to be really important in the view of the great majority of mycologists, including "applied mycologists". I suggest these for consideration: *Tilletia Triticis*, *T. laevis*, *Ustilago levis*, *Rhizopus nigricans*, and especially about a score of pre-Friesian names of Powdery Mildews used by Salmon and all subsequent mycologists, and which could be badly confused by anyone who tried to interpret the Rules to the letter.

'2. That Article 57 be rewritten about as follows: *Among Ascomycetes and Basidiomycetes (but not Phycomycetes) with pleomorphic life-cycle, the first valid binary name applied to the perfect state of a species takes precedence. The names of imperfect states can still be used, and should be used when it is ambiguous to use the name of the perfect state.*

'For example, mycologists use, and it should be legal to use, *Cladosporium herbarum* Fr. despite the fact that its perfect state *Sphaerella Tulasnei* Jancz. has been found and verified. It may be misleading to cite, e.g., *Pyrenophora teres* from a country where only the *Helminthosporium* stage is known.'

I realize that Congress has rejected proposals to conserve specific names of Phanerogams, but I see no reason why mycologists should not give formal consideration to the above and other proposals aiming at clarification of the Rules for nomenclature of Fungi, and at stabilization of scientific names.

CONCLUSIONS AND PROSPECTS

By J. RAMSBOTTOM

The different aspects of nomenclature commented on by the previous speakers are obviously interwoven; indeed, it is obvious that the latter have practised a self-denying ordinance. What must always be borne in mind is the essential distinction between taxonomy and nomenclature. All decisions about status, whether they concern individual organisms or major groups, are taxonomy; nomenclature relates only to the names which shall be used when those taxonomic decisions have been made.

It follows from this that the plea for fixity of names concerns nomenclature. Rules of nomenclature aim at strict and clear applications of names; their object is stability, not change. Taxonomy on the other hand is ever changing, and as it can never reach perfection will continue to change; it cannot be kept in fetters by nomenclature. With every change in taxonomic rank there must be a corresponding change in name. Further there is the healthy symptom that systematists differ in their interpretation of facts, and mycologists, with a rapidly advancing subject, are liable to more than the average differences of opinion.

The one fixed point is the name or epithet used in a given rank. This has priority with the exceptions: (a) it must not antedate the starting point for the group, (b) there must not be a homonym in another group, (c) a generic name may have a later name conserved against it, (d) there must not already exist the same epithet in a genus to which a species is transferred—and this whether the old specific name is in use or not.

This brings us to Dr Bisby's proposal for conserving specific names. The same proposal has been brought forward at every international botanical congress and has always been rejected; it was included in a list of recommendations circulated by Dr C. L. Shear for consideration at Stockholm.

At first sight there appears no logical basis for not allowing specific *epithets* to be conserved in the same way, and for the same reasons, as generic names. The proposal has, however, always been for the conservation of specific *names*, i.e. the binary name consisting of a generic name and a specific epithet, and we then have taxonomic complications. It has to be realized that a fungus may have more than one valid name as a species, and valid names in other ranks. The genus *Tricholoma*, for example, has been split into several smaller genera, *Melanoleuca*, *Rhodopaxillus*, *Rhodocybe*, which may or may not be adopted. We immediately have two valid names for many species:

Tricholoma melaleucum (Pers. ex Fr.) Quél.

[*Melaleuca vulgaris* Pat. (non *Melaleuca* L. Myrtaceae).]

Melanoleuca vulgaris (Pat.) Pat.].

Melanoleuca melaleuca (Pers. ex Fr.) n.comb.

Further, a species may be regarded by some authors as belonging to one genus, by others to another. Thus some species pass from *Clitocybe* to *Tricholoma* according to different authors, or from *Marasmius* to *Collybia*, from *Cantharellus* to *Clitocybe*, and so on. Again we may have at least two valid names.

As an example of different names according to rank, *Volvaria surrecta* (Knapp) Ramsb. is the correct name for the species, and *Volvaria hypopitys* subsp. *Loveiana* (Berk.) Konr. & Maubl. for the subspecies (see *Trans. Brit. myc. Soc.* xxv, 326 (1942)). It is because of difficulties such as these that I, personally, am not in favour of the proposal. We could eventually have a list of standardized fungus-names similar to the American horticulturists' 'Standardized Plant Names', but this would make for taxonomic stagnation.

On the other hand some restricted conservation of specific epithets might be advantageous. Every systematist must constantly come across specific epithets which antedate those in common use and thinks it well to pass them over. What is the better course to follow when one realizes that Balsamo first named the fungus of muscardine *Botrytis paradoxa*, and then, wishing to honour Bassi's classical researches on the disease, renamed it *Botrytis Bassiana*, a name universally adopted? Should one 'refuse to look out of the window' or should one adopt the attitude that a wrong should be righted and, transferring the species to the genus *Beauveria*, write *Beauveria paradoxa* (Bals.) n.comb.? The very fact that many hesitate to apply the Rules because of the consequences suggests that some modification is necessary.

The Rules permit of orthographic and typographic changes in names; in other words corrections of unintentional slips, as e.g. *Battarraea* for *Batarrea*. The changes made in generic (and specific) names by Clements and Shear are unfortunate because *The Genera of Fungi* is much used by students. Confusion is bound to follow the use in yeasts of *Isomyces* for *Debaryomyces*, *Thelis* for *Hanseniospora*, *Zonosporis* for *Schwanniomyces*, even if *Schizosaccharis* and *Zygosaccharis* can readily be collated with *Schizosaccharomyces* and *Zygosaccharomyces* respectively. These are not orthographic corrections, but new names. Consequently they can never be used unless the names they are intended to replace are invalid: they are still-born.

The two kinds of synonyms called obligate and facultative by Mr Mason require to be distinguished. It has been customary to call the former absolute synonyms or typonyms, as they are based on the same type (my colleague, Mr A. J. Wilmott, uses the term isonym for substitute names, i.e. the same concept and the same circumscription). They are purely nomenclatural in character. Very occasionally there is a homonym which is an absolute synonym, e.g. *Ashbya* Guilliermond and *Ashbia* Cif. & Frag., both with *Nematospora Gossypii* Ash. & Nowell as the type. The latter kind of synonyms, for which I know no special term, are taxonomic; they are judged to refer to the same genus or species.

The other matter referred to by Mr Mason is double citation; the special point he makes has been generally overlooked by mycologists.

Fifty years ago Oldfield Thomas, a former Museum colleague, distinguished various kinds of types and so was instrumental in getting more precision in defining types and eventually the adoption of the type method. Botanists were long in adopting this method. It was proposed by some American botanists at Vienna (1905) but was not accepted and for this and other reasons a separate American code was drawn up. At Brussels (1910) the International Congress adopted the type method for future work: at Cambridge (1930) the method was adopted in its entirety. The adoption of the type method has helped to clarify our ideas but it has not removed all our difficulties as many of its advocates assumed it would, overlooking the consequences of sound taxonomic work having been accomplished by other methods.

The Cambridge Congress laid down that when a species was transferred from one genus to another the name of the original author should be given in brackets followed by that of the author who made the transference. Previous to this it was sufficient to give the name of the latter. (The authority is not part of the name, but is merely an abbreviated—often too abbreviated—reference. It should never be used with a query if the type method is followed.) Zoologists do not use double citation of this kind. If a transference has been made the name of the original author is put in brackets, i.e. the authority who first made the transference is omitted.

The second author's name serves many uses, though these have mainly to do with the convenience of taxonomists. The zoological method obviates certain nomenclatural difficulties. Such difficulties occur when for some reason or other an investigator wrongly identifies a species on which he is working with one previously described, and transfers it correctly to another genus. His account may be full, excellent and well illustrated, and he may distribute specimens. His work may be outstanding and constantly referred to. What is to be done? There was some ambiguity in the Cambridge Rules and the subject was discussed at Amsterdam. It was decided 'When, on transference to another genus, the specific epithet has been applied erroneously in its new position to a different plant, the new combination must be retained for the plant on which the epithet was originally based, and must be attributed to the author who first published it'. This 'as to name only' treatment, 'excluding description', is illogical and detrimental to taxonomy. The main purpose of the use of the second authority, a reference to the reasons for making the transfer, is here converted into something which, at best, is an accidental transference made in error. As a mycologist I would prefer to see the error admitted and the specific epithet regarded as new, i.e. omit the author's name within brackets.

The method of double citation has been in more general use in mycology than in other groups, probably because Saccardo used it in his *Sylloge*. It has to be realized, however, that there it has nothing to do with the type method but simply means that the author whose name is within brackets first used the specific epithet for what is presumably the same species. The first species may be the type or it may not—the association of the two species may be nomenclatural or it may be taxonomic. Thus, the specific epithet *purpureum* probably gave Saccardo the clue to the identity of Tulasne's *Hypochnus* and Patouillard's *Helicobasidium*: Tulasne first used the epithet so his name goes within brackets. Many

such examples can be found in the *Sylloge* especially amongst parasitic species named after host plants, e.g. *Urocystis Gladioli*.

De Toni decided on taxonomic grounds that *Urocystis Gladioli* W. G. Sm. is the same species as *Uredo Gladioli* Requien, so (Requien). Requien's specimen was said to be in De Candolle's herbarium; no type of W. G. Smith's species can be found. Dodge and Laskaris based their *Papulaspora Gladioli* on Requien's description; they may be right, they may be wrong, but they have made the combination *Papulaspora Gladioli* (Req.) Dodge & Laskaris, and this name stands or falls according as Requien's species is, or is not a *Papulaspora*; if it falls there can be no *Papulaspora Gladioli*. *Urocystis Gladioli* W. G. Sm. does not come into this picture at all. (Incidentally it may be pointed out that Smith considered the possibility of his species being a *Papulaspora*.) While I was writing up these comments a paper by Hotson appeared which supports the idea widely held in this country that there are two different fungi concerned. He proposes the name *Papulaspora Gladioli* H. H. Hots. for *Papulaspora Gladioli* (Req.) Dodge & Laskaris. This name is both illegitimate and illogical in every way. If Hotson believed that Dodge and Laskaris are wrong in their determination he should have proposed an entirely new specific epithet. Until taxonomy has played its proper part it would be wise not to add further to the nomenclatural tangle.*

The point made by Dr Bisby about a fungus with a pleomorphic life-cycle having only one valid name is taken, I think, too literally. If the perfect stage is present, its name should be used; if the conidial stage alone, its name. Anything other than this is confusing and the point should be made clear in the Rules. We need not take into account such names as *Rhizomorpha subterranea* and *Sclerotium roseum*.

The various Congresses have apparently been lax in coming to decisions. There was no time to consider mycology in particular at Cambridge; at Amsterdam various proposals were shelved—I was mainly responsible for this, for it was obvious that we had not the facts on which to come to well-considered decisions. Points which were up for consideration were:

(1) *List of proposed nomina genera conservanda*. An original list had been prepared by Saccardo for the Vienna Congress but apparently was not published. Lists by Maire, Shear and Jaczewski were before the Amsterdam Congress, but as these were bald proposals it was unwise to vote on them. When nothing seemed likely to be done otherwise before the Stockholm Congress I proposed that the Council of the British Mycological Society should set up a Committee to provide the evidence on which judgment might be based. This Committee has done excellent work and has initiated several members into the problems of nomenclature in a practical and useful way.

(2) *Starting point for nomenclature*. The starting points adopted at Brussels were a compromise. There are again proposals (a) that Linné's *Species Plantarum* should be the starting point for all groups; (b) that Persoon's *Synopsis* should be taken as the starting point for other fungi as well as Rusts, Smuts and Gasteromycetes.

Until we know what sort of changes would be involved it would be foolish to make a change. In collaboration with Miss Stephens I am trying to get some idea of the effect of the adoption of either of these proposals.

(3) *Fries's Systema Mycologicum* (1821–1832). What interpretation is to be put upon this? One view is that the work and not the date is the important point, and that each group of fungi treated in the *Systema* has its starting point at the date it appeared there. Prof. C. W. Dodge had stressed the date: everything starts from 1821. I gained the impression that the majority at the meeting favoured Dodge's view. There can be little doubt that the former view is the more logical but the latter may be the more expedient. As there is a difference in interpretation, the obvious solution is to find out what practical differences in nomenclature would result, and then to adopt that bringing about least change in common practice.

(4) *Fries's subgenera of Agaricus*. The proposal to treat the subgenera in the *Systema* as of generic rank is an example of a proposal which might easily be adopted at a Congress through misunderstanding of the true position. Nothing would be gained by merely taking the *Systema*; indeed that is an understatement. The subgenera which have been used as if they were genera are those of *Hymenomyces Eurobaei* 1874!

All these proposals need to be discussed and decisions made.

A further point that should be considered is the use of generic names in other than the

* The name *Papulaspora Dodgei* Connors has now been proposed to replace *P. Gladioli* H. H. Hots.

original sense. If we attempt to disregard the material differences that have arisen in the interpretation of some of these names there will be great confusion. Most mycologists have adopted Saccardo's interpretation of these generic concepts—a fact which led T. Petch to propose that mycological nomenclature should start with the *Sylloge*—and a way of implementing this practice should be adopted. I intend to put forward the proposal that when common usage follows Saccardo in using a generic name in a different sense from that in which it was originally proposed, Saccardo's name should be treated as a later homonym and conserved.

Also there is a need for some recognized method of quoting errors of identification. We have an appalling array of these in the genus *Russula*. Thus *Russula sardonias* Bres. as commonly written suggests that Bresadola wrongly proposed an illegitimate name for a new species of *Russula*, whereas what he did was to misidentify *Russula sardonias* Fr.

The suggestions made by Dr Bisby show that there is ambiguity in some of the Rules. Where this is so, the ambiguity should be removed. Examples of special cases would do much towards this end.

As I view the future of nomenclature its success or failure depends on the clear recognition of the cleavage between it and taxonomy. Nomenclature is the handmaiden of taxonomy, not the mistress.

PROCEEDINGS

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 21 February 1942.

The President, Miss E. M. BLACKWELL, M.Sc., F.L.S., in the Chair.

Morning Session

W. G. KEYWORTH. *Verticillium* Wilt of hops.

A detailed study of *Verticillium* Wilt of the hop was started at the East Malling Research Station in 1938 to follow up the work of Mr R. V. Harris.

The main symptoms are yellowing and desiccation of the leaves and brown discoloration of the wood in affected stems. The fungus most frequently isolated from affected plants is *Verticillium albo-atrum* but three outbreaks are known to have been caused by *V. Dahliae* (considered as distinct from *V. albo-atrum* because of constant cultural differences). *V. albo-atrum* has been isolated from the roots, stems and leaves of affected plants, and it often produces spores abundantly in the field on moribund stems and leaves.

Seventy-two outbreaks are known and wide variations in severity and persistence have been noted among them. Some fluctuate annually in severity and others become progressively more extensive year by year. The latter type has been studied in detail and observations and experiments have shown that the disease may be spread by the transport of infected plant debris on the cultivators, by the wind dispersal of infected leaves, and in diseased cuttings. Potatoes and raspberries affected with *Verticillium* Wilt have been found in association with wilted hops.

The control measures at present advised are mainly hygienic precautions, designed to remove sources of infection. Soil treatment with eight gallons of 2% formalin per square yard reduces soil infection considerably and is now advised in attempting to eradicate new outbreaks. No commercial hop varieties are resistant although some seedling varieties show possible resistance.

F. BAKER. Decomposition of cellulose in dung by fungi and bacteria.

Cellulose is birefringent and the cellulose components of plant structures appear brilliantly illuminated between the crossed nicols of the polarizing microscope. Where disintegration of the cellulosic substratum is taking place double refraction ceases and such regions appear as dark patches of well-defined contour. Using a method based on these facts observations were made on the breakdown of cellulose which occurs under anaerobic conditions in the alimentary canal of domestic herbivora and that taking place under aerobic conditions in the voided faeces. The first of these processes which is due to the activity of idophile bacteria is exercised only upon substrata, such as the cellulosic components of young plant tissues, whose content of encrusting substances is very restricted. The second process, however, results from the activity of fungi, which is exercised upon the lignified structures that have accumulated in the large bowel; residues which for the most part derive from older vegetable materials. It has been ascertained by observations on the decomposition in dung of the epicarpal hairs of cereal grains, which are voided unchanged, that the cytoclastic process follows the lines of least resistance in the material and that the details of the process find a parallel in the fungal decomposition of wood tracheids. It is clear that the close parallel which can be drawn between the decomposition of dung and the rotting of wood devolves upon a distinctive functional characteristic of the agents of disintegration concerned; namely the ability, widespread among fungi, to gain access to the cellulose embodied in the fine-structural edifice of the ligno-cellulose complex.

Afternoon Session

Discussion on the use and misuse of nomenclature:

Miss E. M. WAKEFIELD. Why rules? (see p. 428).

E. W. MASON. New species and old (see p. 433).

G. R. BISBY. Who is the author? (see p. 434).

J. RAMSBOTTOM. Conclusions and prospects (see p. 436).

Meeting held in the rooms of the Linnean Society of London, Burlington House, Piccadilly, London, W. 1, 24 April 1942.

The President, Miss E. M. BLACKWELL, M.Sc., F.L.S., in the Chair.

C. T. INGOLD. Aquatic hyphomycetes of decaying oak leaves.

Miss D. ASHWORTH. A *Papulaspora*-like fungus from tulip bulbs.

The occurrence of *Papulaspora Gladioli* in America on gladiolus corms in store seems to make it worth while to record a similar fungus first isolated from tulip bulbs at the Royal Horticultural Society's Laboratory at Wisley, some fifteen years ago. No evidence of pathogenicity was obtained. The fungus was briefly described and evidence put forward for its acceptance as a *Papulaspora* though a specific name was not suggested.

C. G. DOBBS. Spore dispersal in the Mucorales.

Figures in current text-books which suggest that *Mucor* sporangia burst and disperse their spores in air are inaccurate, and in particular one of Brefeld's which is incorrectly described in several text-books as of a sporangium shedding its spores gives a false impression. It is uncertain what are referred to in many descriptions and drawings of sporangia, and the importance needs stressing of distinguishing clearly sporangia from sporangial drops, and of stating under what conditions sporangia are figured.

A simple technique for blowing spores has been found useful in separating and isolating fungi, as well as in testing their dispersal in air. The examination of mucors grown in specially built cells made of coverslip glass with a cellulose cement, and the use of simple pyrex glass spore blowers, have made it possible to distinguish a number of preliminary dispersion types among the Mucorales.

The main fact which emerges is that the *Mucor* sporangium is primarily a water-dispersal mechanism, and that *Mucor* spores for the most part become air-borne only after preliminary separation in water, and then usually on the surface of soil dust particles or hyphal fragments. *M. hiemalis* is an almost complete *spore-retainer* in air. *M. Rouxianus*, however, when over six months old disperses fragments of broken hyphae bearing separated spores or spore masses, when subjected to gentle blowing. *M. racemosus* distributes chlamydospores also in its hyphal fragments, as well as shedding some spore masses without hyphae. *Absidia glauca* is a *spore-mass-shedder* without much hyphal dispersal. It sheds no single spores but is well adapted both to air and water dispersal. *Rhizopus nigricans*, however, is definitely adapted to air dispersal. The rough spores are not readily water dispersed. The bell-shaped collapsed columella, long known, but still incorrectly figured in text-books, can remain erect on its rigid stalk, still able to shed viable spores, for as long as three years at least. Blowing broadcasts spore masses of varying size, and single spores provided the material is quite dry. It is therefore called a *dried-spore-shedder*. Finally, some of the conidial types are direct *spore-shedders* comparable with many hyphomycetes.

Realization that the *Mucor* sporangium is primarily a water-dispersal mechanism makes it more comparable with other soil fungi, especially the soil Oomycetes, and many of the variations from the *Mucor* type become intelligible as adaptations to air dispersal. The discovery of a new species of *Piptocephalis* growing on a *Penicillium* was reported, and a culture was shown of a large species of *Mucor* collected near Bristol, and identified provisionally as *Mucor plasmaticus* v. Tiegh.

P. H. GREGORY. Dissemination of fungus spores in air.

Investigations on the air transmission of fungus diseases to new areas generally give most attention to how far and how high spores are transported by air currents. There is little printed work giving details of the different amounts of disease (or the number of spores deposited) at short distances. Under field conditions, when the isolation of plants is generally incomplete, the relation between the degree of infection and distance from an infected area is at times important, and from the fact that certain series of printed observations on a number of diseases are in agreement with Stepanoff's formula $y = C + \frac{a}{sx}$ it is thought that the dissemination in air of spores is a process which may be measured quantitatively.

E. C. BADCOCK. Exhibit of sporophores of some wood-rotting fungi produced in culture on sawdust medium.

PHYTOPATHOLOGICAL EXCURSION 1942

The seventeenth Annual Phytopathological Excursion was held at the Department of Plant Pathology at Rothamsted Experimental Station, Harpenden, by invitation of Mr F. C. Bawden, Head of the Department, on Friday, July 24th, 1942. During the morning informal demonstrations were given of the work on virus diseases and diseases of cereals in progress in the laboratories. A demonstration of the methods used in spectroscopic plant analysis was given immediately before lunch by Dr J. B. Hale. The afternoon was given up to field demonstrations arranged by the Subcommittee on Plant Disease Measurement to illustrate their methods. Much interest was shown in this work and many promises of help were received. About forty members and guests were present.

LIST OF MEMBERS

Correct to 18 November 1942

Honorary Members

- Lister, Miss Gulielma, F.L.S., 871 High Road, Leytonstone, London, E. 11. (1903.) (1924.)
 Maire, René, D.Sc., F.M.L.S., Professeur à la Faculté des Sciences de l'Université,
 Algiers, Algeria, N. Africa. (1907.) (1939.)
 Petch, T., B.A., B.Sc., North Wootton, King's Lynn, Norfolk. (1911.) (1941.)
 Rea, Carleton, B.C.L., M.A., 6 Barbourne Terrace, Worcester. (1896.) (1918.)
 Wakefield, Miss E. M., M.A., F.L.S., Herbarium, Royal Botanic Gardens, Kew, Surrey.
 (1911.) (1941.)

Ordinary Members

- Aberdeen, The University Library. (1916.)
 Adams, Rev. J. H., Landulph Rectory, Hatt, Saltash, Cornwall. (1919.)
 Ainsworth, G. C., B.Sc., Ph.D., Imperial Mycological Institute, Ferry Lane, Kew, Surrey.
 (1931.)
 Alaily, Y. A. S. El, Mycological Section, Cotton Research Board, Giza, Egypt. (1935.)
 Alberta, University of Edmonton, Alberta, Canada. (1924.)
 Alcock, Mrs N. L., M.B.E., F.L.S., 61 Holywell, Oxford. (1919.)
 Armitage, F. D., A.R.P.S., F.R.M.S., Bargrove Lodge, Boxmoor, Herts. (1942.)
 Ashby, S. F., B.Sc., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1926.)
 Bacon, Mrs Alice, B.Sc., F.L.S., Technical College, Brighton, Sussex. (1938.)
 Barnes, B., D.Sc., Ph.D., V.-P.L.S., Chelsea Polytechnic, London, S.W. 3. (1922.)
 Barr, Rev. Robert, T.D., M.A., The Manse, Neilston, Renfrewshire. (1918.)
 Barrington, Dr F. J. F., 48 Wimpole Street, London, W. 1. (1901.)
 Bartlett, A. W., M.A., M.Sc., F.L.S., Department of Botany, King's College, Newcastle-
 on-Tyne. (1920.)
 Baruah, Hitendra Kumar, M.Sc., The Botany School, Cambridge. (1938.)
 Bates, G. R., Ph.D., c/o British South Africa Company, Mazoe Citrus Estate, Mazoe,
 S. Rhodesia. (1930.)
 Bawden, F. C., M.A., Rothamsted Experimental Station, Harpenden, Herts. (1941.)
 Beardslee, H. C., Perry, Ohio, U.S.A. (1933.)
 Beaumont, Albert, M.A., Seale-Hayne Agricultural College, Newton Abbot, Devon. (1924.)
 Bewley, W. F., C.B.E., D.Sc., Experimental and Research Station, Cheshunt, Herts. (1922.)
 Biffen, Professor Sir Rowland H., M.A., F.R.S., 136 Huntingdon Road, Cambridge. (1899.)
 Biologist, Plant Research Laboratory, Horticultural Gardens, Burnley, Victoria, Australia.
 (1921.)
 Birmingham Natural History and Philosophical Society, c/o Mrs O. W. Thompson,
 18 Hermitage Road, Edgbaston, Birmingham. (1920.)
 Bisby, Guy R., Ph.D., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1921.)
 Blackman, Professor V. H., M.A., Sc.D., F.R.S., F.L.S., 17 Berkeley Place, Wimbledon,
 London, S.W. 19. (1900.)
 Blackwell, Miss Elizabeth Marianne, M.Sc., F.L.S., Botanical Department, Royal
 Holloway College, Englefield Green, Surrey. (1917.)
 Blumer, Dr S., Myrtenweg 12, Bern-Bumpliz, Switzerland. (1936.)
 Bonn, Germany, Institut für Pflanzenkrankheiten, Nuss-Allee 9. (1931.)
 Boston, The Mycological Club, Horticultural Hall, Boston, Mass., U.S.A. (1926.)
 Bourgin, Dr Viennot, École Nationale d'Agriculture de Grignon, Seine-et-Oise, France.
 (1936.)
 Braid, Professor K. W., B.A., B.Sc., West of Scotland Agricultural College, 6 Blythwood
 Square, Glasgow. (1922.)

- Brazier, E., Ty'n-y-gongl, Love Lane, Stourbridge. (1921.)
- Brenchley, G. H., B.A., Clare College, Cambridge. (1925.)
- Brett, Miss M., M.Sc., Ph.D., F.L.S., Northern Polytechnic, Holloway Road, London, N. 7. (1921.)
- Brierley, Professor W. B., D.Sc., F.R.A.I., F.L.S., Department of Agricultural Botany, The University, Reading. (1919.)
- British Museum, The Trustees of, Cromwell Road, South Kensington, London, S.W. 7. (1914.)
- Brooks, Professor F. T., M.A., F.R.S., F.L.S., The Botany School, Cambridge. (1907.)
- Brown University, Library, East side Station, Providence, R.I., U.S.A. (1920.)
- Brown, Professor W., M.A., D.Sc., F.R.S., Imperial College of Science, South Kensington, London, S.W. 7. (1922.)
- Bruxelles, Jardin Botanique de l'État, c/o M. P. van Aerdschot. (1911.)
- Buckley, W. D., 'St Anthony', Leigh Park, Datchet, Bucks. (1916.)
- Buddin, Walter, M.A., Laboratory of Plant Pathology, University of Reading, 7 Redlands Road, Reading. (1921.)
- Buller, Professor A. H. R., D.Sc., Ph.D., F.R.S., c/o Herbarium, Royal Botanic Gardens, Kew, Surrey. (1911.)
- Bunting, R. H., F.L.S., 3 Stanton Court, Weymouth. (1921.)
- Burges, N. A., The Botany School, Cambridge. (1935.)
- Burr, S., M.Sc., Department of Agriculture, The University, Leeds. (1924.)
- Butler, Sir E. J., C.I.E., C.M.G., D.Sc., M.B., F.R.S., F.L.S., 22 Newnham Avenue, Bedford. (1920.)
- Caldwell, J., D.Sc., Ph.D., Department of Botany, University College, Exeter. (1932.)
- Callen, E. O., 9 Lauderdale Street, Edinburgh, 9. (1941.)
- Cambridge, The Botany School. (1920.)
- Campbell, A. H., B.Sc., Ph.D., Department of Botany, The University, Bristol. (1934.)
- Carmichael Medical College, Belgachia Road, Calcutta, India. (1922.)
- Carrothers, E. N., L.M.S. Railway, York Road Station, Belfast. (1925.)
- Cartwright, K. St G., M.A., F.L.S., The Old Vicarage, Towersey, Thame, Oxon. (1913.)
- Cayley, Miss Dorothy M., Foxhall Cottage, Kelshall, nr. Royston, Herts. (1913.)
- Charles, Miss Vera K., United States Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1933.)
- Chaudhuri, Professor H., M.Sc., Ph.D., University of the Punjab, Lahore, India. (1920.)
- Cheal, W. F., Gosmoor Lane, Elm, nr. Wisbech, Cambs. (1927.)
- Chesters, C. G. C., B.Sc., M.Sc., Ph.D., Department of Botany, The University, Edgbaston, Birmingham. (1930.)
- Ciferri, Professor Dr R., Assistant Director, Laboratorio Crittogamico, Casella Postale 165, Pavia, Italy. (1926.)
- Clapham, A. R., M.A., Ph.D., Department of Botany, The University, Oxford. (1931.)
- Cleland, J. Burton, M.D., Professor of Pathology, University of Adelaide, South Australia. (1918.)
- Clouston, D., M.A., B.Sc. (Agr.), North of Scotland College of Agriculture, Crown Mansions, 41 Union Street (2nd Floor), Aberdeen. (1931.)
- Colson, Miss B., B.Sc., Ph.D., Department of Botany, The University, Reading. (1934.)
- Connecticut Agricultural Experiment Station, New Haven, Connecticut, U.S.A. (1929.)
- Cook, W. R. I., B.Sc., Ph.D., Department of Botany, University College, Newport Road, Cardiff. (1924.)
- Cooke, G. J., 143 Newmarket Road, Norwich. (1933.)
- Cooke, Mrs G. J., 143 Newmarket Road, Norwich. (1937.)
- Cooper, Miss Charlotte A., California Lane, Bushey Heath, Herts. (1911.)
- Cooper, Mrs V. Astley, South Lodge, Reading Road, Cholsey, Wallingford, Berks. (1921.)
- Cornell University, The Library, New York State College of Agriculture, Ithaca, N.Y., U.S.A. (1920.)

- Corner, E. J. H., M.A., F.L.S., Assistant Director, Botanic Gardens, Singapore, Straits Settlements. (1924.)
- Cotton, Arthur D., O.B.E., F.L.S., Keeper, Herbarium, Royal Botanic Gardens, Kew, Surrey. (1902.)
- Croxall, H. E., B.Sc., Research Station, Long Ashton, Bristol. (1937.)
- Curtis, Miss Kathleen M., M.A., D.Sc., D.I.C., F.L.S., Mycologist, Biological Department, Cawthron Institute of Scientific Research, Nelson, New Zealand. (1917.)
- Cutting, E. M., M.A., F.L.S., Botanical Department, University College, Gower Street, London, W.C. 1. (1920.)
- Dade, H. A., A.R.C.S., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1927.)
- Davies, D. L. G., Ph.D., Agricultural Buildings, University College of Wales, Aberystwyth. (1938.)
- Davies, D. W., B.Sc., Adviser in Mycology, Agricultural Buildings, University College of Wales, Aberystwyth. (1923.)
- Day, W. R., B.A., B.Sc., Imperial Forestry Institute, Oxford. (1928.)
- Deacon, Dr G. E., Brundall, Norwich. (1933.)
- Dehra Dun, The Forest Botanist, Forest Research Institute and College, U.P., India. (1929.)
- Deighton, F. C., M.A., Mycologist, Department of Lands and Forests, Freetown, Sierra Leone, West Africa. (1925.)
- Delhi, Imperial Mycologist, Imperial Agricultural Research Institute, Delhi, India. (1921.)
- Dennis, R. W. G., Ph.D., Plant Pathology Service, Seed Testing Station, East Craigs, Edinburgh, 12. (1932.)
- Dickinson, S., Ph.D., School of Agriculture, Cambridge. (1921.)
- Dobbs, C. G., B.Sc., Ph.D., Botanical Department, King's College, Strand, London, W.C. 2. (1933.)
- Dodge, Dr Carroll W., Missouri Botanical Garden, 2315 Tower Grove Avenue, St Louis, Missouri, U.S.A. (1926.)
- d'Oliveira, Dr Branquinho, Linha de Cascaes, Parede, Portugal. (1939.)
- Dowson, W. J., M.A., D.Sc., The Botany School, Cambridge. (1920.)
- Duncan, J. T., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1930.)
- Dunston, Capt. Ambrose E. A., Burltons, Donhead St Mary, Wiltshire (via Shaftesbury). (1937.)
- Elliott, Mrs J. S. Bayliss, D.Sc. (B'ham), B.Sc. (London), Arden Grange, Tanworth-in-Arden, Warwickshire. (1911.)
- Ellis, E. A., Castle Museum, Norwich. (1937.)
- Ellis, E. H., B.Sc., Gramarye, Farley Green, Guildford, Surrey. (1936.)
- Emerson, R., Dept. of Botany, University of California, Berkeley, Calif., U.S.A. (1938.)
- Emoto, Dr Y., Biological Department, Peers' College (Gakushuin), Mejiromachi, Tokyo, Japan. (1929.)
- Essex Field Club, c/o Mr Percy Thompson, F.L.S., Essex Museum of Natural History, Romford Road, Stratford, London, E. 15. (1919.)
- Exeter, Librarian, University College of the South-West of England. (1926.)
- Eyre, Miss J. C., Wellbottom Lodge, Moulton, nr. Newmarket. (1915.)
- Fenton, E. W., M.A., B.Sc., F.L.S., Biology Department, Edinburgh and East of Scotland College of Agriculture, Edinburgh. (1920.)
- Findlay, W. P. K., D.Sc., A.R.C.S., Forest Products Research Laboratory, Princes Risborough, Bucks. (1928.)
- Finlayson, Raymond A., F.L.S., Official Seed Testing Station, Huntingdon Road, Cambridge. (1910.)
- Fisher, S. D. P., Sackville Street, Leeds. (1930.)
- Fitzpatrick, Professor H. M., Ph.D., 220 Bryant Avenue, Ithaca, New York, U.S.A. (1935.)
- Fletcher, Mrs P. T., B.A., 137 Tonbridge Road, Maidstone, Kent. (1935.)

- Foister, C. E., B.A., Ph.D., Plant Pathology Service, Seed Testing Station, East Craigs, Edinburgh, 12. (1940.)
- Fraser, Miss Lilian R., D.Sc., Botany School, The University, Sydney, New South Wales. (1938.)
- Gadd, C. H., D.Sc., Tea Research Institute, Nuwara Eliya, Ceylon. (1921.)
- Gardner, Capt. Frederic, c/o Barclays Bank, Jersey, C.I. (1898.)
- Garrett, S. D., M.A., Ph.D., Rothamsted Experimental Station, Harpenden, Herts. (1936.)
- Ghamrawy, Ali K., 39 Monirah Street, Cairo, Egypt. (1932.)
- Gilbert, E. J., Docteur en Pharmacie, 4 Rue de Musset, Paris (16^e), France. (1924.)
- Gilbert, Dr E. M., Botanical Department, University of Wisconsin, Madison, Wis., U.S.A. (1922.)
- Gill, G. E., LL.B., Law Library, Four Courts, Dublin. (1937.)
- Gillespie, J., B.Sc., Botany Dept., University of Reading. (1938.)
- Gilson, Mrs M. R. [née Brown], Newnham College, Cambridge. (1936.)
- Glenn, Miss E. M., B.Sc., East Malling Research Station, nr. Maidstone, Kent. (1942.)
- Glynne, Miss Mary D., M.Sc., F.L.S., Rothamsted Experimental Station, Harpenden, Herts. (1932.)
- Gorman, M. J., A.R.C.Sc.I., Albert Agricultural College, Glasnevin, Dublin. (1925.)
- Gould, F. G., Woodrising, Trapps Hill, Loughton, Essex. (1918.)
- Graddon, W. D., Berry Bank, Howey Hill, Congleton, Cheshire. (1942.)
- Gray, Miss E. G., B.Sc., Ph.D., West of Scotland Agricultural College, 6 Blythswood Square, Glasgow. (1942.)
- Gregory, P. H., Ph.D., Rothamsted Experimental Station, Harpenden, Herts. (1930.)
- Grinling, C. H., B.A., 71 Rectory Place, Woolwich, London, S.E. 18. (1913.)
- Groves, J. Walton, Central Experiment Farm, Ottawa, Canada. (1942.)
- Gwynne-Vaughan, Professor Dame Helen, G.B.E., D.Sc., LL.D., F.L.S., 93 Bedford Court Mansions, London, W.C. 1. (1906.)
- Hanna, W. F., M.Sc., Ph.D., Dominion Rust Research Laboratory, Agricultural College, Winnipeg, Canada. (1925.)
- Hansford, C. G., M.A., F.L.S., Mycologist, Department of Agriculture, Kampala, Uganda. (1921.)
- Harley, J. L., M.A., D.Phil., Department of Botany, The University, Oxford. (1932.)
- Harris, G. C. M., 148 Divinity Road, Oxford. (1934.)
- Harris, R. V., B.Sc., A.R.C.S., East Malling Research Station, nr. Maidstone, Kent. (1924.)
- Harrison, T. H., D.Sc., Australia House, Strand, London, W.C. 2. (1931.)
- Harvard University, The Library, Cambridge, Mass., U.S.A. (1923.)
- Hastings, Somerville, M.S., F.R.C.S., 43 Devonshire Street, Portland Place, London, W. 1. (1913.)
- Hawker, Miss L. E., Ph.D., Botanical Department, Imperial College of Science, South Kensington, London, S.W. 7. (1934.)
- Heim, Roger, Sous-Directeur au Muséum d'Histoire Naturelle, 11 Rue de Médecis, Paris (6^e), France. (1930.)
- Heimbeck, Mrs Louise, Brosoe, Levanger, Norway. (1923.)
- Hemmi, Dr Takewo, Phytopathological Institute, Department of Agriculture, Kyoto Imperial University, Kyoto, Japan. (1923.)
- Hereford, E. H., 131 Queen Victoria Street, London, E.C. 4. (1933.)
- Hickman, C. J., M.Sc., Long Ashton Research Station, Field Laboratory, Abbey Road, Evesham. (1935.)
- Holden, H. S., D.Sc., F.R.S.E., F.L.S., Forensic Science Laboratory, Burton Street, Nottingham. (1923.)
- Honolulu, Association of Hawaiian Pineapple Cannerys, P.O. Box 3166, Hawaii. (1929.)
- Honolulu, The Library, Experimental Station, S.P.A., Box 411, Hawaii. (1920.)
- Howard, H. J., F.R.M.S., F.L.S., Lingfield, 6 College Road, Norwich. (1918.)
- Hubbard, Miss M. D., B.Sc., Laren, Western Drive, Littleover, Derby. (1933.)

- Hughes, G. C., Priory Road, Bicester. (1898.)
- Hughes, J. S., M.A., The Firs, Great Rollright, Chipping Norton, Oxon. (1927.)
- Hughes, S. J., B.Sc., Advisory and Research Dept. in Agricultural Botany, University College, Cathays Park, Cardiff. (1941.)
- Hull, R., B.Sc., Ph.D., A.R.C.S., Midland Agricultural College, Sutton Bonington, Loughborough. (1942.)
- Hull, The Librarian, Botanical Department, University College. (1929.)
- Humphrey, Dr C. J., 543 No. La Cienega Blvd., Los Angeles, California. (1921.)
- Hurst, C. P., F.L.S., Landulph Rectory, Saltash, Cornwall. (1928.)
- Ingold, C. T., D.Sc., Ph.D., F.L.S., Department of Botany, University College, Leicester. (1935.)
- Iowa, The Library, State University of Iowa, Library Annex, Iowa City, U.S.A. (1923.)
- Iowa State College, Library, Ames, Iowa, U.S.A. (1927.)
- Issatchenko, Professor Dr B. L., Nowinskii B. 25, log. 11, Moscow 69, U.S.S.R. (1923.)
- Jenkins, Miss Anna E., Bureau of Plant Industry, Department of Agriculture, Washington, D.C., U.S.A. (1942.)
- John Crerar Library, 86 East Randolph Street, Chicago, Illinois, U.S.A. (1929.)
- Johnstone, R. H., 726 Anniesland Road, Glasgow, W. 4. (1938.)
- Jones, G. H., M.A., Kasenga, Stanley Avenue, Chesham, Bucks. (1922.)
- Jørstad, Ivar, Statsmykolog, Botanisk Museum, Oslo, Norway. (1923.)
- Keay, Miss M. A., M.A., Ph.D., Department of Agricultural Botany, The University, Reading. (1935.)
- Keissler, Dr Karl, Direktor d. Botanischen Abteilung, Naturhistorisches Museum, Burgring 7, Wien 1/1, Austria. (1924.)
- Kelly, Dr Howard A., 1418 Eutaw Place, Baltimore, Md., U.S.A. (1921.)
- Keyworth, W. G., Ph.D., D.I.C., East Malling Research Station, nr Maidstone, Kent. (1941.)
- Klika, Bohumil, Hálkova, 37 Prague, Vrsovice 553 Czechoslovakia. (1926.)
- Knight, H. H., M.A., The Lodge, All Saints' Villas, Cheltenham. (1914.)
- Kuala Lumpur, F.M.S., The Director of Agriculture, Straits Settlements and Federated Malay States. (1930.)
- Leach, R., B.A., Department of Agriculture, Kingston, Jamaica. (1929.)
- Leicester, The Museum, City of Leicester. (1923.)
- Likhite, Dr Y. N., Department of Agriculture, Baroda State, India. (1936.)
- Linder, Dr D., Farlow Herbarium, Harvard University, 20 Divinity Avenue, Cambridge, Mass., U.S.A. (1935.)
- Line, James, M.A., School of Agriculture, Cambridge. (1921.)
- Linnean Society, The, Burlington House, Piccadilly, London, W. 1. (1919.)
- Lloyd Library, The, 309 West Court Street, Cincinnati, Ohio, U.S.A. (1907.)
- Loader, Miss F. M., B.Sc., Botanical Department, University College, Southampton. (1927.)
- Long, Mrs E. M. [née Ellis], B.A., B.Sc., Riversdale, Waddington Road, Clitheroe, Lancs. (1930.)
- Lütjeharms, Professor W. J., Phil.Nat.D., Department of Botany, University College, Bloemfontein, Orange Free State, S. Africa. (1930.)
- Macdonald, James A., Botany Department, The University, St Andrews. (1938.)
- McKay, Robert, B.Sc., A.R.C.S.I., Department of Plant Pathology, Albert Agricultural College, Glasnevin, Dublin. (1939.)
- Manchester, The University of, Department of Cryptogamic Botany, Manchester. (1940.)
- Marsh, R. W., M.A., Research Station, Long Ashton, Bristol. (1923.)
- Masefield, G. B., c/o Department of Agriculture, Entebbe, Uganda. (1932.)
- Mason, E. W., M.A., M.Sc., F.L.S., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1921.)
- Mason, Mrs E. W., M.Sc., Inglenook, 63 King's Road, Richmond, Surrey. (1922.)
- Mathias, W. T., B.Sc., The University, Liverpool. (1938.)

- Matthews, Professor J. R., M.A., F.L.S., Department of Botany, The University, Old Aberdeen. (1921.)
- Mehta, Professor K. C., Ph.D., Department of Biology, Agra College, Agra, U.P., India. (1921.)
- Metcalf, C. R., B.A., Ph.D., Jodrell Laboratory, Royal Botanic Gardens, Kew, Surrey. (1926.)
- Michigan Agricultural College Library, East Lansing, Michigan, U.S.A. (1924.)
- Miller, Professor J. H., B.S., M.S., Ph.D., University of Georgia, Athens, Ga., U.S.A. (1930.)
- Millidge, P. H., 205 Carisbrooke Road, Newport, I.O.W. (1937.)
- Missouri Botanical Garden, The, St Louis, Mo., U.S.A. (1902.)
- Mitra, M., M.Sc., Ph.D., D.I.C., Assistant Mycologist, Imperial Institute of Agricultural Research, Delhi, India. (1928.)
- Miyabe, Dr Kingo, Professor Emeritus of Botany, Hokkaido Imperial University, Sapporo, Japan. (1919.)
- Montague, Mrs A., Penton, Crediton, N. Devon. (1898.)
- Montgomery, H. B. S., B.A., Ph.D., D.I.C., East Malling Research Station, nr. Maidstone, Kent. (1940.)
- Montreal, Institut Botanique de l'Université, 4101 Est, Rue Sherbrooke, Canada. (1932.)
- Moore, M. H., East Malling Research Station, nr. Maidstone, Kent. (1940.)
- Moore, W. C., M.A., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1922.)
- Morgan, Dr G., Ashley-Hatton, Dyke Road Avenue, Brighton. (1928.)
- Morris, L. E., c/o Eton College, Windsor, Berks. (1924.)
- Muller, Dr H. R. A., c/o Internatio, Semarang, Java. (1932.)
- Murray, G. H., F.E.S., Director of Agriculture, Rabaul, New Britain, Territory of New Guinea, via Australia. (1921.)
- Muskett, A. E., M.Sc., A.R.C.S., Queen's University, Belfast, Northern Ireland. (1923.)
- Nannfeldt, Professor J. A., Sturegatan 11, Uppsala, Sweden. (1932.)
- Nash-Worthington, J. R. H., Abingdon, Gatesden Road, Fetcham, Leatherhead, Surrey. (1937.)
- National Collection of Type Cultures, Curator, Lister Institute, Elstree, Herts. (1921.)
- National Museum of Wales, Cardiff. (1924.)
- Nattrass, R. M., B.Sc. (Agric.), Ph.D., Department of Agriculture, P.O.B. 338, Nairobi, Kenya. (1925.)
- Nederlandsche Mycologische Vereeniging, The Librarian, Zoornweg 10, Wageningen, Holland. (1920.)
- Neiderhausen, J. S., Dept. of Plant Pathology, New York State College of Agriculture, Cornell University, Ithaca, N.Y., U.S.A. (1941.)
- Newcastle-on-Tyne, The Librarian, King's College. (1928.)
- New York Botanical Garden, Bronx Park, New York, U.S.A. (1904.)
- Noble, Miss Mary, B.Sc., Ph.D., 19a Willowbrae Avenue, Edinburgh. (1940.)
- Noel, Miss E. F., F.L.S., 37 Burnham Court, Queen's Road, London, W. 2. (1913.)
- North Carolina, Library, University of, Chapel Hill, North Carolina, U.S.A. (1920.)
- Notley, Miss M. E., O.C.H.F., St Mary's Convent, Baldslow, St Leonards-on-Sea, Sussex. (1942.)
- Nursery and Market Garden Industries' Development Society, Ltd., Experimental and Research Station, Cheshunt, Herts. (1922.)
- O'Connor, P., Ph.D., B.Sc., A.R.C.Sc.I., National Museum, Dublin. (1925.)
- Ogilvie, L., M.A., M.Sc., Research Station, Long Ashton, nr Bristol. (1922.)
- Oke, Alfred William, B.A., F.G.S., F.L.S., 32 Denmark Road, Hove, Sussex. (1908.)
- Olliver, C. W., c/o Lloyds Bank Ltd., 50 Notting Hill Gate, London, W. 11. (1942.)
- Ontario Agricultural College, Library, Guelph, Ontario, Canada. (1920.)
- Osborn, Professor T. G. B., D.Sc., F.L.S., Department of Botany, The University, Oxford. (1910.)
- Oyler, Miss E., Experimental and Research Station, Cheshunt, Herts. (1937.)

- Padwick, Dr G. Watts, Imperial Agricultural Research Institute, New Delhi, India. (1936.)
- Page, Miss W. M., M.Sc., Ph.D., 5 Dartmouth Chambers, Theobald's Road, London, W.C. 1. (1921.)
- Parke Davis and Co., Medical Research Library, P.O. Box 488, Detroit, Michigan, U.S.A. (1920.)
- Parker, Professor C. S., Department of Botany, Howard University, Washington, D.C., U.S.A. (1932.)
- Patrick, Miss S. H. M., Elmsleigh House, Stoughton Avenue, Leicester. (1937.)
- Pearson, Arthur A., F.L.S., Nutcombe House, Hindhead Road, Hindhead, Surrey. (1911.)
- Peklo, Dr Jaroslav, Professor of Applied Botany, Bohemian Technical University, Charles Square, Prague II, Czechoslovakia. (1924.)
- Pershhouse, Mrs Stanley, Denhem Lodge, Yelverton, S. Devon. (1937.)
- Perthshire Society of Natural Science, c/o J. F. Cumming, Esq., 12 Barossa Place, Perth. (1919.)
- Pethybridge, G. H., O.B.E., Ph.D., B.Sc., F.L.S., Penlee, Harleigh Road, Bodmin, Cornwall. (1919.)
- Peyronel, Dr Benjamin, R. Istituto Sup. Agrario e Forestale, Piazzale del Re, Firenze, Italy. (1932.)
- Philadelphia, The Academy of Natural Sciences of Philadelphia, Nineteenth and The Parkway, Phil., U.S.A. (1925.)
- Phillips, Dr H. H., 11 Kings End, Bicester, Oxon. (1923.)
- Ping, A. Wentworth, M.A., St Olave's, Clifton, York. (1926.)
- Potter, Rev. M. C., Sc.D., M.A., F.L.S., Corley Croft, New Milton, Hants. (1896.)
- Preston, N. C., B.Sc., Harper Adams Agricultural College, Newport, Salop. (1920.)
- Pretoria, South Africa, The Librarian, Division of Botany and Plant Pathology, P.O. Box 994. (1922.)
- Ramsbottom, J., O.B.E., Dr.Sc., M.A., F.L.S., British Museum (Nat. Hist.), Cromwell Road, South Kensington, London, S.W. 7. (1910.)
- Rauter, Dr F., 28 Clarendon Road, London, W. 11. (1942.)
- Ray, Miss Anne, Penarwyn, Gorran Haven, Gorran, Cornwall. (1929.)
- Rayner, Dr M. Cheveley (Mrs Neilson Jones), Bedford College for Women, Regent's Park, London, N.W. 1. (1921.)
- Rees, John, M.Sc., Adviser in Agricultural Botany, University College, Cardiff. (1929.)
- Reichert, Dr Israel, Jewish Agency for Palestine, Agricultural Experiment Station, P.O.B., 15 Rehoboth, Palestine. (1924.)
- Rhodes, Miss Mabel, Lister Institute, Chelsea Gardens, London, S.W. 1. (1921.)
- Robinson, E., 26 Burwood Avenue, Eastcote, Pinner, Middlesex. (1938.)
- Rothamsted Experimental Station, Department of Plant Pathology, Harpenden, Herts. (1923.)
- de Rousset-Hall, O., B.A., Department of Botany, The University, Oxford. (1942.)
- Royal Holloway College, Englefield Green, Surrey. (1942.)
- Rutgers College and State University of New Jersey, Library, New Brunswick, New Jersey, U.S.A. (1922.)
- St Paul, Minnesota, U.S.A., The Library, Department of Agriculture University Farm. (1920.)
- Sampson, Miss K., M.Sc., Agricultural Buildings, Aberystwyth, North Wales. (1920.)
- Samuel, Geoffrey, M.Sc., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1923.)
- Scott, W. W., 13 Bishop's Road, Highgate, London, N. 6. (1922.)
- Searle, G. Odell, B.Sc. (Agric.), Flax Research Institute, Flitcham Abbey, nr King's Lynn, Norfolk. (1920.)
- Seth, N. L., B.Sc., Ph.D., D.I.C., Agricultural College, Mandalay, Burma. (1930.)
- Shear, Dr C. L., U.S. Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1930.)
- Skene, Professor Macgregor, Department of Botany, The University, Bristol. (1936.)

- Smith, Alexander, M.A., Ph.D., Ministry of Agriculture, Pathological Laboratory, Milton Road, Harpenden, Herts. (1924.)
- Smith, G., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1936.)
- Smith, Professor Noel J. G., Ph.D., B.Sc., Botany Department, Rhodes University College, Grahamstown, S. Africa. (1924.)
- Smith, Rupert, 38 Greenhill Gardens, Edinburgh. (1927.)
- South London Botanical Institute, 323 Norwood Road, Tulse Hill, London, S.E. 24. (1921.)
- Sowter, F. A., 9 North Avenue, Leicester. (1942.)
- Stakman, Professor E. C., University of Minnesota, Department of Agriculture, University Farm, St Paul, Minn., U.S.A. (1922.)
- Statham, Miss E. M., 2 Westbrook Road, Blackheath, London, S.E. 3. (1926.)
- Stationery Office, H.M., Superintendent of Publications, Book Dept., Westminster, S.W. 1. (4 subscriptions.) (1920.)
- Stephens, Miss E. L., B.A., Department of Botany, University of Cape Town, South Africa. (1928.)
- Stephens, Miss F. L., M.Sc., Department of Botany, British Museum (Natural History), Cromwell Road, South Kensington, London, S.W. 7. (1930.)
- Steven, W. F., 8 Dynevor Road, Richmond, Surrey. (1937.)
- Stevenson, Dr J. A., U.S. Department of Agriculture, Bureau of Plant Industry, Washington, D.C., U.S.A. (1937.)
- Steyaert, R. L., Ing. A.I.Gx., Laboratoire Bambesa, Uele, Belgian Congo. (1931.)
- Stiles, Professor W., Sc.D., F.R.S., Department of Botany, The University, Edgbaston, Birmingham. (1936.)
- Stirrup, H. H., M.Sc., Midland Agricultural College, Sutton Bonington, Loughborough. (1922.)
- Storey, H. H., M.A., Ph.D., East African Agricultural Research Institute, Amani, Tanganyika Territory, East Africa. (1922.)
- Storey, S. F., Ph.D., 7 Redlands Road, Reading, Berks. (1941.)
- Sutherland, G. K., M.A., D.Sc., F.L.S., The Moorings, Rosemary Hill, Streetly, Sutton Coldfield, Birmingham. (1914.)
- Swanton, E. W., M.B.E., A.L.S., Educational Museum, Haslemere, Surrey. (1899.)
- Swedish Academy of Sciences, Royal, Stockholm, Sweden. (1919.)
- Sydney, Australia, The Librarian, University of. (1922.)
- Sydow, H., Luitpoldstrasse 33, Berlin, W. 30, Germany. (1931.)
- Tennessee, University of, Agricultural Experiment Station, Library, Knoxville, Tennessee, U.S.A. (1926.)
- Tervet, I. W., B.Sc., Department of Plant Pathology, University Farm, St Paul, Minn., U.S.A. (1933.)
- Thompson, Miss E. C., East Malling Research Station, nr. Maidstone, Kent. (1942.)
- Thurston, Miss J. M., B.Sc., Rothamsted Experimental Station, Harpenden, Herts. (1942.)
- Tomkins, R. G., M.A., Ph.D., Trinity College, Cambridge. (1925.)
- Tunstall, A. C., Tocklai Experimental Station, Cinnamara, P.O., Assam, British India. (1933.)
- Turner, Miss E. M., B.A., Ph.D., Royal Holloway College, Englefield Green, Surrey. (1940.)
- Twyman, E. S., Department of Botany, The University, Edgbaston, Birmingham. (1942.)
- Vanterpool, T. C., M.Sc., Botanical Department, University of Saskatchewan, Saskatoon, Canada. (1929.)
- Venkataraman, S. V., Senior Assistant Mycologist, Agricultural Department, Bangalore, S. India. (1935.)
- Wadham, Professor S. M., M.A., Department of Agriculture, The University, Melbourne, Victoria, Australia. (1922.)
- Waldie, J. S. L., B.Sc., C.D.A., Department of Agricultural Botany, The University, Reading. (1925.)

- Wales, University College of, Librarian, Botanical Department, Aberystwyth, North Wales. (1927.)
- Wallace, E. R., Agricultural Institute, Kirton, nr Boston, Lincs. (1934.)
- Wallace, G. B., B.Sc. (Agric.), Ph.D., c/o Mrs G. Wallace, 19 Joppa Road, Portobello, Midlothian, Scotland.
- Wallis, A., Westacre, Station Road, Kettering. (1921.)
- Ware, W. M., D.Sc., South-Eastern Agricultural College, Wye, Kent. (1924.)
- Warne, Mrs M. M., B.A., 25 Amherst Road, Fallowfield, Manchester, 14. (1937.)
- Waterhouse, Miss G. M., M.Sc., 95 Knightwood Crescent, New Malden, Surrey. (1927.)
- Waterston, J. M., B.Sc., Mycologist, Department of Agriculture, Paget East, Bermuda. (1934.)
- Watson, W., D.Sc., A.L.S., Cedene, Cheddon Road, Taunton. (1923.)
- Webb, Dr Phillip, The Yews, Chadlington, Oxford. (1938.)
- Webb, R. A., B.A., D.Phil., Biochemistry Dept., London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C. 1. (1936.)
- Wellington, New Zealand, Plant Research Bureau. (1940.)
- Westerdijk, Professor Johanna, Javalaan 4, Baarn, Holland. (1923.)
- Western, J. H., B.Sc., Ph.D., Adviser in Mycology and Agricultural Botany, The University, Manchester, 13. (1934.)
- Weston, W. A. R. Dillon, M.A., Ph.D., School of Agriculture, Cambridge. (1923.)
- Whetzel, Professor H. H., M.A., New York State College of Agriculture, Cornell University, Ithaca, N.Y., U.S.A. (1914.)
- Whitaker, F. Owen, 51 Grosvenor Avenue, Carshalton, Surrey. (1921.)
- Whitehead, T., D.Sc., A.R.C.S., University College of North Wales, Bangor. (1920.)
- Wilkins, W. H., M.A., D.Phil., Department of Botany, The University, Oxford. (1928.)
- Wilkinson, E. H., Research Station, Long Ashton, Bristol. (1938.)
- Williams, P. H., B.Sc., Experimental and Research Station, Cheshunt, Herts. (1930.)
- Wilson, Miss A. P., M.B.E., A.R.C.S., 7a Arlington Drive, Nottingham. (1929.)
- Wilson, Alastair R., Ph.D., Midland Agricultural College, Sutton Bonington, Loughborough. (1933.)
- Wilson, Miss Irene M., B.Sc., Ph.D., Botany Department, University College of Wales, Aberystwyth. (1938.)
- Wilson, Malcolm, D.Sc., A.R.C.S., F.L.S., Royal Botanic Garden, Edinburgh. (1921.)
- Wiltshire, S. P., D.Sc., Imperial Mycological Institute, Ferry Lane, Kew, Surrey. (1920.)
- Wisconsin, The Library, University of, Madison, Wis., U.S.A. (1923.)
- Wolf, B. L., N.D.A., Cornwall Buildings, 45 Newhall Street, Birmingham. (1923.)
- Wolf, Dr F. A., Dept. of Botany, Duke University, Durham, North Carolina, U.S.A. (1940.)
- Wolf, Dr F. T., Vanderbilt University, Nashville, Tennessee, U.S.A. (1940.)
- Wood, F. C., The Rest, Franklin Road, Durrington, Worthing. (1935.)
- Woodcock, A. J. A., M.Sc., F.E.S., Rhianva, 65 Rock Avenue, Gillingham, Kent. (1926.)
- Woodward, R. C., Ph.D., Hawthorndale Laboratories, Agricultural Research Station, Jealott's Hill, nr. Bracknell, Berkshire. (1924.)
- Woolhope, The Naturalists' Field Club, Hereford. (1896.)
- Worcestershire Naturalists' Field Club, Worcester. (1921.)
- Wormald, H., D.Sc., A.R.S.C., East Malling Research Station, nr. Maidstone, Kent. (1921.)
- Yale University, Library, New Haven, Connecticut, U.S.A. (1930.)
- Yeoman, J. B., M.D., F.R.C.S., Norton, Wirral, Cheshire. (1934.)
- Yuill, E., Norwood, Towthorpe Lane, Haxby, York. (1937.)
- Zundel, Dr G. L. I., Botany Building, Pennsylvania State College, State College, Pa., U.S.A. (1929.)
- Zürich, Switzerland, Botanical Garden and Museum, c/o Dr A. U. Däniker. (1921.)
- Zürich, Institut für Spezielle Botanik der Eidg. Techn. Hochschule. (1928.)

Members are requested to notify the Treasurer (A. A. Pearson) and the Secretary (G. C. Ainsworth) of any change of address.

INDEX

New names are indicated by an asterisk

- Abies, 57
 nobilis, 299, 301
 Normanniana, 299
 pectinata, 299
 Absidia glauca Hagem, 441
 Abutilon, 287
 Abutilon Virus 1, 287
 Acanthostigma parasiticum Sacc., 299
 Accounts, 3, 228
 Acer, 131
 campestre, 300
 Pseudoplatanus (Sycamore), 71, 98, 299,
 300
 Achlya Nees, 322
 Achorion Schoenleinii Leb., 58
 Acorus, 94
 Calamus, 427
 Acremonium Link ex Fr., 59, 264
 Cleoni Wize, 263, 264, 265
 Danyszii Wize, 264, 265
 soropsis Wize, 264, 265
 Acridium peregrinum, 258
 Acrospeira B. & Br., 342
 levis Wiltsh., 342
 Acrosporium Nees, 57
 Acrostalagmus Corda, 261, 262
 Acrotheca Fuckel, 94
 Acrothecium Corda em. Preuss, 87, 91
 Actinomyces Harz, 340, 410
 scabies (Thaxt.) Güss., 58, 272
 tumuli Millard & Beeley, 282
 Actinonema Fr., 297
 Aquilegiae (Roum. & Pat.) Grove, 287
 Crataegi Pers., 86
 Adoxa, 94
 Aecidium Periclymeni Schum., 275
 pseudo-columnare Kühn, 299
 Aegerita Pers. ex Fr., 62, 67
 Aesculus (horse chestnut), 169
 Agaricus Dill., 220
 Agaricus Linn., 86, 428, 432, 438
 caseus With., 326
 exsuccus Knapp, 220
 infector Knapp, 326
 integer Linn., 220
 (Volvaria) Loveianus Berk., 326
 pulvinatus Bolt., 326
 surrectus Knapp, 326, 327
 Agave, 287
 Agriotes, 147
 Agropyron, 147
 acutum, 277
 repens, 277
 Agrostis, 73, 102, 147, 276
 Ainsworth, G. C., A method for character-
 izing smut fungi exemplified by some
 British species, 141
 see Bisby, G. R.
 Aira caespitosa, 277
 flexuosa, 277
 Ajuga, 94
 Akanthomyces aculeata Leb., 68, 74, 306
 *Alatospora Ingold, n.gen., 384, 413
 *acuminata Ingold, n.sp., 340, 381, 382,
 383, 384, 411, 413, 416, 417
 Alchemilla, 84
 arvensis, 76
 Aldridgea Mass., 431
 Aleurodes, 54, 262
 vaporariorum, 262
 Aleurodiscus amorphus (Pers.) Rabenh., 299
 Alisma, 94
 Allium, 69, 91, 92, 102, 147
 ascalonicum (shallot), 281
 Cepa (onion), 69, 71, 102, 216, 281, 421
 Porrum (leek), 281
 Schoenoprasum, 281
 triquetrum, 27, 32, 37, 38
 ursinum, 37
 vineale, 281
 Allomyces E. J. Butler, 192, 193
 arbuscula E. J. Butler, 192
 Alnus, 79, 86, 94
 glutinosa (alder), 79, 86, 94, 300, 339, 341,
 352, 353, 357, 359, 360, 362, 363, 369,
 376, 381, 384, 385, 386, 389, 392, 393,
 394, 398, 404, 408, 409
 Alopecurus, 67
 alpinus var. robustus, 275
 pratensis, 275
 Alternaria Nees ex Wallr., 97, 99, 271, 273, 299
 Brassicae (Berk.) Sacc., var. nigrescens
 Pegl., 97
 Peglionii Curzi, 271
 radicina Maier, Drechsler & Eddy, 282, 427
 Solani (E. & M.) Jones & Grout., 337
 tenuis Nees ex Wallr., 98, 100, 434, 435
 Tomato (Cooke) L. R. Jones, 85, 98, 427
 Althaea rosea (hollyhock), 166, 287
 Amanita Dill., 220
 caesarea (Bull.) Fr., 220
 Eliae Qué!, 223
 muscaria Fr., 434
 ovoidea Bull., 208
 Amanitopsis fulva Sacc., 223
 vaginata Fr., 326
 American Gooseberry mildew, 5, 16, 284, 285
 Ammophila, 100
 Amygdalus persica (peach), 12, 92, 246, 247,
 284, 338
 Anabaena, 43
 Anemone, 147
 coronaria, 287
 japonica, 287
 Angelica, 86, 94
 *Anguillospora Ingold, n.gen., 401, 412, 413
 *longissima (Sacc. & Syd.) Ingold, n.comb.,
 340, 398, 399, 400, 402, 406, 411, 413,
 416, 417
 Anguillulina dipsaci, 271, 272, 291, 292, 294,
 295, 297
 graminis, 275

- graminophila, 276
 pratensis, 290
 tritici, 271
 Angular Leaf Spot, 20
 Annual General Meetings, by J. Ramsbottom,
 14 December 1940, 1
 13 December 1941, 226
 Antholyza, 93
 Anthostomella pullulans Bennett, 53
 Taxi Grove, 304
 Anthoxanthum odoratum, 276
 Anthriscus, 54, 94
 Antirrhinum, 215
 majus, 287
 Antirrhinum Rust, 269
 Antirrhinum Shot Hole, 269
 Aphanomycetes euteiches Drechsl., 279, 280,
 292, 298
 Aphelenchoides fragariae, 286
 olesistus, 291
 ritzema-bosi, 290
 Aphis, 56
 Apiocrea Syd., 80, 427
 chrysosperma (Tul.) Syd., 80, 172
 Tulasneana (Flowr.) Petch, 81
 Apionectria Sacc., 80, 427
 Apium, 88
 graveolens (celery), 281, 282
 Aplanobacter insidiosus McCull., 311
 Rathayi E. F. Smith, 312
 Apple Canker, 8
 Apple Scab, 5, 9, 10
 Aquatic hyphomycetes of decaying alder
 leaves, by C. T. Ingold, 339
 Aquatic hyphomycetes of decaying oak leaves,
 by C. T. Ingold, 441
 Aquilegia, 73
 vulgaris, 287
 Arabis albida, 287
 alpina, 280
 Arctium, 94
 Arenaria, 94
 Armeria, 288
 Armillaria mellea (Vahl) Quél., 73, 104, 201,
 204, 220, 272, 285, 286, 289, 290, 293,
 296, 297, 298, 299, 301, 302, 303, 304
 Armoracia rusticana, 282
 Arrhenatherum, 147
 avenaceum, 276
 elatus, 73
 Artemisia, 89
 Arthrinium Kunze ex Fr., 68, 71, 72
 *Articulospora Ingold, n.gen., 376, 413
 *tetracлада Ingold, n.sp., 340, 372, 373,
 374, 375, 376, 391, 406, 413, 416, 417
 Arum, 94, 99, 102, 215
 Arundo, 76
 Donax, 175
 Ascochyta Armoraciae Fuckel, 282
 Fabae Speg., 280
 graminicola Sacc., 277
 Kabatiana Trott., 292
 Philadelphii Sacc. & Speg., 295
 pinodella L. R. Jones, 293
 Pisi Lib., 279, 280, 293
 Primulae Trail, 295
 ribesia Sacc. & Fautr., 285
 rufomaculans (Berk.) Berk., 432
 Trifolii Bond. & Truss., 274
 Violae Sacc. & Speg., 299
 Aseroe Labill., 336
 Ashbia Cif. & Frag., 437
 Ashbya Guillerm., 437
 Ashworth, D., 'A *Papulaspora*-like fungus from
 tulip-bulbs', 441
 Asparagus, 102
 plumosus, 288
 Asparagus Rust, 268
 Aspergillus Mich. ex Fr., 76, 103
 aurantiacus (Desm.) Berk., 76
 glaucus Link ex Fr., 68, 69
 niger v. Tiegh., 68, 71
 restrictus G. Smith, 427
 Tamarii Kita, 287
 Aspidium, 291
 aculeatum, 334
 Aster, 72, 94, 288
 Asteroma Ulmi Klotzsch, 305
 Asterothrix raphidioides, 368, 370
 Athyrium, 89
 Atichia, by F. L. Stephens and J. Ramsbottom,
 337
 Atriplex, 80
 Atropa Belladonna, 288
 Aucuba japonica, 288
 Auricula, 92
 Avena (oats), 91, 147, 216, 218, 271
 Azalea, 288
 Bacterial Canker, 14, 15, 246
 Bacterial diseases of stone-fruit trees in
 Britain. VIII. Bacterial canker of peach,
 by H. Wormald, 246
 Bacterium Aroideae (Townes.) Stapp, 215, 273
 brassicaevorus Delacr., 273
 Barkeri Elliott, 15
 carotovorum (L. R. Jones) Lehm., 215, 216,
 279, 280, 281, 282, 287, 292
 Delphinii Bryan, 290
 fascians (Tilford) Lacey, 278, 286, 313
 Hycinthi Wakk., 292
 maculicola McCull., 280
 marginale N. A. Brown, 281
 marginatum McCull., 291
 medicaginis (Sacc.) E. F. Sm., var. phaseo-
 licola (Burkh.) G. K. K. Link & Hull,
 280
 phytophthorum (Appel) Stapp, 216, 272,
 278
 Pruni E. F. Sm., 246
 Rathayi (E. F. Sm.) Stapp, 276
 rhaponticum Millard, 282
 Savastanoi E. F. Sm., var. Fraxini N. A.
 Brown, 301
 sepedonicum Stapp, 312
 tumefaciens E. F. Sm. & Towns., 12, 13,
 273, 278, 285, 289, 290, 292
 Bactrodesmium caulicola (Corda) Grove, var.
 pellucidum Grove, 90
 Badcock, E. C., 'New methods for the cultiva-
 tion of wood-rotting fungi', 200
 'Exhibit of sporophores of some wood-
 rotting fungi produced in culture on
 sawdust medium', 442

- Baker, F., 'Decomposition of cellulose by fungi and bacteria', 440
- Barbarea, 94
vulgaris, 280
- Barclayella Diet., 429
- Barclayella Sacc., 429
- Barlaea Reichenb., 428
- Barlaea Sacc., 428
- Barro Colorado Island, An addition to the flora of, by F. T. Wolf, 191
- Bartonia, 288
- Basisporium gallarum Molliard, 75
- Battarrea Pers., 437
- Bawden, F. C., 'Report of sub-committee on plant disease measurement in the field', 218
- Beauveria Vuill., 260
- Bassiana (Bals.) Vuill., 306
*paradoxa (Bals.) Ramsb., n.comb., 436
- Begonia, 288
- Berberis asiatica, 76
vulgaris (barberry), 178, 288
- Beta (beet, mangold), 89, 94, 100, 103, 218, 273, 282
- Beta Virus 2, K. M. Smith, 273
- Betula (birch), 68, 98, 127
alba (birch), 300
- Big Bud of black currant, 19, 53
- Bisby, G. R., 'British species of *Hysterium*, *Gloniopsis*, *Dichaena* and *Mytilidion*', 127
'Who is the author?', 434, 441
see Wakefield, E. M.
and Ainsworth, G. C., 'On the numbers of fungi', 219
- Bispora monilioides Corda, 82, 84
- Black Leg of potato, 216
- Black Root Rot of strawberry, 18
- Black Rot of crucifers, 268
- Black Rust, 218
- Blackwell, E. M., Waterhouse, G. M. and Thompson, M. V., 'The invalidity of the genus *Pythiomorpha*', 148, 219
- Blastocladia Reinsch, 318, 319, 325
globosa Kanouse, 320
glomerata Sparrow, 318, 319, 320, 324
gracilis Kanouse, 317, 318, 319, 324, 325
incrassata Indoh, 318
Pringsheimii Reinsch, 317, 318, 320, 324
ramosa Thaxt., 318, 319, 324
truncata Sparrow, 320
- Blastotrichum Corda, 60, 103
- Blepharospore Petri, 152
cambivora Petri, 152, 153
- Blossom Wilt, 5, 11, 12, 20
- Blue Stripe of raspberry, 17
- Boletus Dill., 220
- Boletus (Dill.) Pat., 80, 81, 93, 172
- Boron deficiency, 273
- Botryosphaeria Ces. & de Not., 297
- Botrytis Mich. em. Link, 27, 28, 36, 37, 38, 61, 71, 73, 77, 83, 291
Allii Munn, 281
anthophila Bond., 274
Bassiana Bals., 436
cinerea Pers. ex Fr., 26, 27, 28, 29, 69, 70, 71, 102, 272, 273, 278, 279, 280, 281, 283, 285, 286, 287, 288, 289, 290, 291, 293, 295, 296, 297, 299, 342, 434
f. Lini van Beyma Thoe Kingma, 305
- convoluta Whetzel & Drayton, 26
- Douglasii Tub., 301, 303
- elliptica (Berk.) Cooke, 293
- Eriophyes Massee, 53
- galanthina (B. & Br.) Sacc., 291
- Gladioli Kleb., 291
- globosa Raabe, 37
- lateritia Fr., 53
- narcissicola Kleb., 27, 28, 31, 35, 36, 294
- Paeoniae Oudem., 294
- paradoxa Bals., 436
- parasitica Cav., 70, 71
- polyblastis Dowson, 27, 29, 30, 31, 32, 33, 34
- Rileyi Farl., 261
- Tulipae (Lib.) Lind., 298
- Bovista Dill., 220
- Brachycladium Corda, 88, 90
- Brassica, 63, 89, 97, 166, 174, 280, 282
arvensis, 280
Napus (turnip), 216, 273
oleracea (cabbage), 58, 86
Rapa, 96
- Brassica Virus 1 K. M. Smith, 280, 289, 293
- Brassica Virus 2 K. M. Smith, 273
- Brassica Virus 3 K. M. Smith, 280
- Bremia Lactucae Regel, 281
- Bresadolina Speg., 431
- British Hyphomycetes, List of, 49, 427
- British Hypocreales, Further notes on, by T. Petch, 166
- British species of *Hysterium*, *Gloniopsis*, *Dichaena* and *Mytilidion*, by G. R. Bisby, 127
- Briza media, 277
- Bromus, 87, 147, 271
mollis, 217
sterilis, 217
- Brooks, F. T., 'Phytopathological observations in Australia and New Zealand, 1939', 215
- Brown Canker of rose, 269
- Brown Rot, 5, 11, 12, 20, 218
- Brown Rust, 218
- Brunchorstia destruens Erikss., 302, 303
- Bulb Rot of *Scilla nutans* caused by *Penicillium cyclopium* Westling, by B. Singh, 194
- Bulgaria Fr., 82
- Bunt of wheat, 216
- Burrillia Setchell, 145
- Buxus (box), 60, 62, 177
sempervirens (box), 288
- Byssocladium fenestrale Link, 68
- Byssus Linn., 102
- Caeoma Alliorum Link, 281
Laricis Plowr., 301
- Caladium, 75
- Calceolaria, 70, 288
- Calendula, 89, 288
- Callistephus (China aster), 64, 288, 421
- Calloria fusarioides (Berk.) Fr., 54
- Calluna vulgaris, 289
- Calonectria de Not., 175, 176, 178
belonospora Schroet., 178
coccidophaga Petch, 256, 257
fulvida Ell. & Everh., 178

- graminicola (B. & Br.) Wollenw., 65, 298
 Hirsutellae Petch, 257
 pseudopeziza (Desm.) Sacc., 175, 176, 292
 *truncata Petch, n.sp., 257
 xantholeuca (Kunze) Sacc., 175
 Caltha, 94
 Camellia, 99
 Campanula, 94, 95, 289
 glomerata, 289
 latifolia, 289
 persicifolia, 289
 rotundifolia, 289
 Candida Berkhout, 53
 Cane Spot of loganberry, 17
 Cantharellus Adans., 436
 Capitophorus fragariae, 19, 262
 Capsella Bursa-pastoris, 280
 Capsicum, 432
 Cardamine, 94
 flexuosa, 280
 hirsuta, 280
 pratensis, 280
 Carduus, 90, 94, 147
 Carex, 62, 68, 72, 73, 84, 147
 Carpinus, 64
 Castanea (chestnut), 97, 208, 300
 Cattleya, 207
 Caulalis, 89
 Cedrus, 300
 Cellulospodium Peck, 429
 Cenococcum geophilum Fr., 126
 Centaurea (sweet sultan), 94, 215
 Cyanus (cornflower), 289
 Scabiosa, 281
 Centranthus, 94
 Centropogon, 262
 Cephalospodium Corda, 56, 261, 262, 342
 Acremonium Corda, 53, 62
 aphidicola Petch, 262, 306
 Bertholletianum Spencer, 287, 427
 coccorum Petch, 261
 Lefroyi Horne, 262
 *subclavatum Petch, n.sp., 262
 verticicolum Petch, 172
 Cephalothecium Corda, 87
 Cephus pygmaeus, 217
 Cerasterias, 367
 raphidioides, 362
 var. incrassata, 370
 Cerastium, 93
 Ceratostomella Sacc., 167
 Piceae Münch, 303
 Pini Münch, 303
 Ulmi (Schwartz) Buism., 269, 305
 Cercopis sanguinea, 20
 Cercospora Fres., 87, 88
 beticola Sacc., 282
 Calthae Cooke, 94
 Caricae Speg., 433
 circumscissa Sacc., 284
 Myrti Erikss., 294
 Roesleri (Catt.) Sacc., 286
 Cercosporella Sacc., 208, 209
 Brassicace (Fautr. & Roum.) v. Hoehn., 89,
 97
 herpotrichoides Fron., 218
 Primulae Allesch., 209, 295, 427
 Chaetomium Kunze, 103
 Chaetosira Clem., 429
 Chaetostroma Corda, 62
 Chamaerops, 93
 Cheiranthus, 69, 97
 Cheiri (wallflower), 289
 Chionaspis, 67
 Chionodoxa Luciliae, 289
 Chlamydomonas, 41, 45
 Chondrioderma spumarioides Rost., 172
 Chromosporium Corda, 71, 76
 Chrysanthemum indicum, 289, 290
 maximum, 290
 Chrysomyxa Abietis Unger, 302
 Rhododendri de Bary, 296, 302
 Ciboria Fuckel, 330
 amentacea Fuckel, 330
 caucus (Reb.) Fuckel, 330
 Cicada, 258
 orni, 258
 plebeja, 258
 Cicuta virosa, 427
 Cineraria, 290
 Cintractia Caricis (Pers.) Magn., 147
 Cirsium, 94
 Cistus, 134
 Citromyces Wehmer, 78
 Citrus (orange), 78, 85
 Cladochytrium caespitis Griff. & Maubl., 298
 Cladosporium Link ex Fr., 20, 73, 86, 100, 102,
 178, 207, 293
 album Dowson, 435
 Aphidis Thuem., 306
 carpophilum Thuem., 84, 86, 284
 cucumerinum Ell. & Arth., 84, 87
 dendriticum Wallr., 86
 fulvum Cooke, 278
 herbarum Link ex Fr., 73, 84, 207, 271, 279,
 291, 292, 295, 434, 435
 Lycopersici Plowr., 85, 98
 orchidearum Cooke & Massee, 207
 'orchidis' Cooke & Massee, 207
 Roesleri Catt., 286
 Cladotrichum Preussii Sacc., 85
 uniseptatum Cooke, 85
 uniseptatum (Berk. & Curt.) Sacc., 87
 Cladrastis, 54
 Clarkia, 215, 290
 Clasterosporium Schwein., 91, 100
 carpophilum (Lév.) Aderh., 284
 Clavaria (Vaill.) Fr., 87, 428
 farinosa (Holmsk.) Dicks., 74
 tenuis Sow., 56
 Clavariopsis De Wild., 359, 362, 374, 387, 413
 Clavariopsis Holtermann, 356
 aquatica De Wild., 219, 340, 341, 353, 354,
 355, 356, 359, 360, 363, 387, 411, 413,
 415, 417
 pinguis Holtermann, 356
 Claviceps Tul., 57, 65
 Junci Adams, 58
 purpurea (Fr.) Tul., 58, 102, 270, 271, 274,
 275, 276, 277
 Clematis, 75, 82, 85, 290
 Cleonus punctiventris, 263, 264
 Clinterium obturatum Fr., 289
 Clitocybe Fr., 436

- Clitocybe nebularis* (Batsch) Fr., 326
 Sadleri Berk., 223
Cnicus arvensis, 281
 lanceolatus, 281
Coccotrichum brevius B. & Br., 69
Cochlearia, 94
 Armoracia, 94
 officinalis, 280
Colchicum, 147
Coleosporium Lév., 302, 303
 Campanulac Lév., 289
 Petasites Lév., 295
 Senecionis Fr., 288, 297
Colletotrichum Corda, 432
 atramentarium (B. & Br.) Taubenh., 272, 278
 Holci (Syd.) Grove, 277
 lagenarium (Passer.) Ell. & Halst., 279
 Lindemuthianum (Sacc. & Magn.) Bri. & Cav., 280
 Lini (Westend.) Toth., 305
 nigrum Ell. & Halst., 432
Collybia Fr., 436
 butyracea (Bull.) Fr., 307
 cirrhatia (Schum. ex Fr.) Quél., 103, 223
 dryophila (Bull.) Fr., 307
 fusipes (Bull.) Berk., 201
 racemosa (Pers. ex Fr.) Quél., 102
 tuberosa (Bull. ex Fr.) Quél., 102
 velutipes (Curt.) Fr., 201, 307
Coltricia (Micheli) S. F. Gray, 185
 dualis (Peck) Faull, 188
 tomentosa (Fr.) Murrill, 180, 182, 184, 185, 188
Coniophora cerebella Pers., 203, 204
 puteana (Schum.) Karst., 304, 305
Coniosporium Link ex Fr., 71, 77
Coniosporium Sacc., 71
 Arundinis Sacc., var. *phaeospermum* (Corda) Trail, 77
Coniothecium Corda, 99
Coniothyrium Corda em. Sacc., 297
 concentricum (Desm.) Sacc., var. *Agaves* Sacc., 287
 Hellebori Cooke & Massee, 292
Conium, 82
Contarinia Nasturtii, 273
Convallaria, 93, 99
Convolvulus, 144, 147
Copranophilus spinuliformis Speg., 174
Coprinus (Pers.) Fr., 307
 domesticus (Bolt. ex Fr.) Fr., 102
 ephemerus (Bull.) Fr., 307, 308, 309
Coprinus ephemerus, tremelloid outgrowths on the pilei of, in artificial culture, by W. G. Keyworth, 307
Copris, 84
 'Copy', preparation of, 211
Cordierites Mont., 336
Cordyceps Fr., 254, 264
 amazonica P. Henn., 255
 citrea Penz. & Sacc., 255
 coccinea Penz. & Sacc., var. *subochracea* Penz. & Sacc., 252
 deflectens Penz. & Sacc., 252
 flavobrunnescens P. Henn., 252
 Fourquignoni Quél., 73, 305
 gracilis (Grev.) Dur. & Mont., 74
 Gryllotalpae Ell. & Seaver, 254
 Gryllotalpae (?), 254, 255
 militaris (Fr.) Link, 54, 250, 251, 305
 mitrata Pat., 252
 sobolifera (Hill.) Sacc., 252, 253, 254
 sphecocephala (Berk.) Berk. & Curt., 74
 sphecocephala (Klotzsch) Cooke, 178, 306
 tuberculata (Lebert) Maire, 258
 typhulaeformis Berk. & Cooke, 251, 252
Coremium Link, 71, 81
 candidum Nees, 77
 gracile Petch, 261
Corticium Pers., 88, 90
 centrifugum (Lév.) Bres., 21, 65
 fuciforme (Berk.) Wakef., 74, 298
 Solani Bourd. & Galz., 102, 272, 273, 278, 280, 281, 285, 286, 287, 288, 289, 293, 295, 296, 298, 301
Corylus Avellana, 300
Corynebacterium Lehm. & Neum., 311, 312
 diphtheriae (Flügge) Lehm. & Neum., 311
 **fascians* (Tilford) Dowson, n.comb., 313
 **flaccumfaciens* (Hedges) Dowson, n.comb., 313
 insidiosum (McCull.) Jensen, 312, 313
 michiganense (Smith) Jensen, 312, 313
 **Rathayi* (E. F. Smith) Dowson, n.comb., 313
 **sepedonicum* (Spieckermann) Dowson, n.comb., 313
Corynella Boudier, 54
Coryneum microstictum B. & Br., 297
Cotoneaster, 290
Covered Smut of barley, 216
Crataegus, 75, 133, 301
 Oxyacantha (hawthorn), 316
 Pyracantha, 86
Creonectria seminicola (Seaver) Seaver, 169
Crepis, 94
Cribraria argillacea Pers., 173
Cristulariella depraehens (Cooke) v. Hoehn., 300
Crocus, 70
 aureus, 290
Cronartium ribicola Fisch. de Waldh., 285, 302
Crouania Ag., 428
Crouania Fuckel, 428
Crown gall, 12, 13
Cryptomeria japonica, 70
Cryptomyces maximus (Fr.) Rehm, 304
Cryptosporium minimum Laub., 297
Cryptostegia, 94
Ctenomyces serratus Eidam, 57
Cucumis Melo (melon), 64, 66, 73, 287
 sativa (cucumber), 66, 69, 84, 87, 89, 90, 97, 216, 279
Cucumis Virus 1 K. M. Smith, 281, 291, 293, 296
Cucurbita Pepo, 279
Cucurbitaria Laburni de Not., 292
 Piceae Borthwick, 302
 pithyophila Fr., 303
Current Leg Spot, 21
Cyclamen, 290
Cydonia (quince), 17
Cylindrium Bon., 71, 97

- Cylindrocarpon* Wollenw., 401
 radicolum Wollenw., 273, 278, 282, 286
Cylindrocephalum stellatum (Harz) Sacc., var.
 claviforme Grove, 67
Cylindrocladium Morgan, 21, 63
Cylindrosporium Unger, 62, 66, 96
 Padi Karst., 284
Cymadothea Wolf, 86
 Trifolii Wolf, 435
Cynosurus cristatus, 277
Cypripedium, 206
 callosum, 206, 207, 210, 427
 insigne, 207
Cystopus candidus (Pers.) de Bary, 273, 280,
 282, 287
 cubicus (Strauss) de Bary, 282
Cytisus, 98
Cytospora chrysosperma (Pers.) Fr., 303
 leucostoma (Pers.) Sacc., 284
Cytosporium Sacc., 429

Dactylis, 67, 87
 glomerata (cocksfoot), 217, 276, 313
Dactylum Nees ex Fr., 84, 85, 86, 87, 90, 93
 Renneyi B. & Br., 85
Daedalacanthus, 93
Dahlia, 74, 147, 290
Dahlia Leaf Spot, 269
Dahlia Virus I K. M. Smith, 290
Darlucua Filum (Biv.-Bern.) Cast., 299
Dasyscypha calyciformis (Willd.) Rehm, 302
 canescens (Phill.) Masee, 67
 resinaria Rehm, 299
 subtilissima Cooke, 302, 303
 Wilkommii (Hart.) Rehm, 301
Daucus Carota (carrot), 282, 427
Davallia, 291
Davies, D. L. G., 'A *Fusarium* wilt of runner
 beans', 419
Debaryomyces Kloeck., 437
Deficiency diseases, 6, 7
Delphinium, 290
Dematium Pers., 53
 griseus Pers., 71
Dematophora Hartig, 72, 73
Dendrodochium album Bayliss Elliott, 54, 427
 citrinum Grove, 54, 427
Dendrophoma pleurospora Sacc., 60
Dendryphiella Bub. & Ran., 91
Dendryphium Wallr., 88, 90
Dennis, R. W. G., and Foister, C. E., 'List of
 diseases of economic plants recorded in
 Scotland', 266
Deutzia, 72
**Dialonectria applanata* (Fuckel) Petch,
 n.comb., 170
 **flammeola* (Weese) Petch, n.comb., 170
 galligena (Bres.) Petch, 168, 171
 sanguinea (Bolt.) Cooke, 170
Dianthus, 61, 65, 66, 93, 97, 99, 147
 barbatus (sweet william), 290
 Caryophyllus (carnation), 64, 290, 291, 313
Diaporthe ambigua Nits., 98
 decedens (Fr.) Fuckel, 170
 umbrina Jenkins, 269
Diatrype Fr., 63
 Stigma (Fr.) Fr., 97, 178

Diatrypella Ces. & de Not., 54
Dichaena Fr., 135, 136, 138, 139
 faginea (Fr.) Fr., 135
 var. *Capreae* Rehm, 136
 quercina (Fr.) Fr., 135, 136
 strobilina (Fr.) Fr., 136
Dichaenopsis Paoli, 135, 136
Dickinson, S., 'Experiments on the physiology
 of obligate parasitism. II', 216
Dictyosporium Corda, 98, 100
 toruloides (Corda) Guéguen, 90, 98
Didymella applanata (Niessl) Sacc., 285, 286
Didymellina Dianthi C. C. Burt, 93, 290
 macrospora Kleb., 292
Didymopsis Helvella (Corda) Sacc. & March.,
 427
Didymostilbe P. Henn., 87
Die Back, 19
Die Back of plum, 14
Diffugia, 387
Digitalis, 96
Digraphis arundinacea, 277
Dillenius as a mycologist—and some odd notes,
 by J. Ramsbottom, 220
Dilophospora Alopecuri (Fr.) Fr., 268, 275,
 276, 277
Diplocarpon Rosae Wolf, 297
Diplocladium Bon., 85, 86
 melleum (B. & Br.) Sacc., 172
 minus Bon., 172
 penicillioides Sacc., 172
 Rennyi (B. & Br.) Sacc., 172
Diplodia natalensis Pole-Evans, 287
 Rhododendri Westend., 296
Diplodina Westend., 215
 Passerini Allesch., 215, 287
Diplophlyctis intestina (Schenk) Schroet., 43
Diplosporium album Bon., var. *fungicola*
 Sacc., 86
Discofusarium tasmaniense (McAlp.) Petch,
 256
Discussion on nomenclature, 428, 441
Diseases of economic plants in Scotland, 266
Doassansia Sagittariae (Westend.) Fisch., 147
Doassansiopsis Diet., 145
Dobbs, C. G., 'Spore dispersal in the Mucor-
 ales', 441
Doronicum, 94
Dothidella Speg., 86
 Trifolii (Pers.) Bayl. Ell. & Stansf., 274
 Ulm Wint., 305
Downy Mildew of sugar beet, 218
Dowson, W. J., 'Soft-rots due to green fluores-
 cent bacteria', 215
 'On the generic name of the Gram-positive
 bacterial plant pathogens', 311
Draacaena, 69
Dwarf Lateral Scorch, 16

Echyna (Pilacre) Petersii Fr., 223
Echinobotryum Corda, 72, 82
Echinodontium tinctorium Ell. & Holw., 203
Elaphomyces Nees, 61
Eleutheromyces Fuckel, 167
 longisporus Phill. & Plowr., 173, 174
Eleutherosphaeria longispora (Phill. & Plowr.)
 Grove, 173

- Elm Disease, 269
 Elodea, 395
Elsinoe veneta (Burkh.) Jenkins, 17, 285
Elymus arenarius, 277
Empusa Cohn, 250
 acarida Petch, 250
 Aulicae Reichardt, 305
 Fresenii Nowak., 305
 Muscae Cohn, 305
Endoconidium temulentum Prill. & Delacr., 329
Entomophthora Aphidis Hoffm., 250, 305
 Lampyridarum Thaxt., 305
Entyloma de Bary, 146
 Calendulae (Oudem.) de Bary, 288
 Dahliae Syd., 147, 290
 Fergussoni (B. & Br.) Plowr., 294
 microsporum (Ung.) Schroet., 147
Epichloe Fr., 58
 typhina (Fr.) Tul., 275, 276, 277
Epilobium, 76, 94, 96
 palustre, 427
 tetragonum, 427
Epochium Link ex Fr., 86, 90, 97
Equisetum, 99
Eremurus, 291
Erianthemum, 93
Erinaceus Dill., 220
Eriophorum, 55
Eriophyes ribis, 53
Erostrotheca Martin & Charles, 73, 435
 multiformis Martin & Charles, 73, 293, 435
Erysiphe Cichoracearum DC., 279, 288, 297
 graminis DC., 270, 271, 274, 275, 276, 277
 horridula (Wallr.) Lév., 294
 Polygoni DC., 273, 274, 279, 280, 282, 290, 293, 304
 Rubi Fuckel, 285
Erythraea, 73
Euonymus, 85
Euphorbia, 291
Eurotium insigne Wint., 54
Eutypa Tul., 170
Eutypella Tul., 15
 Prunastri (Fr.) Sacc., 14
Exoascus Alni B. & Br., 300
Exobasidium Vaccinii (Fuckel) Woronin, 296
 Eye-spot lodging, 218

Fagus (beech), 104, 128, 129, 136, 168, 177, 201, 205, 301
Farinaria Sow., 86
Farlowiella Sacc., 138, 139
Farysia Racib., 144
 olivacea (DC.) Syd., 147
Festuca, 62, 275
 arenaria, 275
 elatio, 275
 ovina, 275
 pratensis, 275
 rubra var. *arenaria*, 275
Ficus, 89
 elastica, 291
Fidicina bonariensis, 258
 Field observations on some cereal diseases and their control, by W. A. R. Dillon Weston, 216

 Fire Blight of pear, 16
 Fish Eye Rot of apple, 21
Fistulina hepatica (Huds.) Fr., 300, 304
 **Flagellospora* Ingold, n.gen., 402, 403, 412, 413
 **curvula* Ingold, n.sp., 340, 402, 403, 404, 413, 417
 Foister, C. E., see Dennis, R. W. G.
Fomes Fr., 55
 annosus Fr., 170, 201, 289, 300, 301, 302, 303
 (*Xanthochrous*) *circinatus* (Fr.) Konr. & Maubl., 179
 connatus Fr., 305
 Demidoffii Lév., 203
 fomentarius (Linn.) Fr., 300, 301
 fraxineus (Bull.) Fr., 301
 geotropus Cooke, 203, 205
 igniarius (Linn.) Fr., 303, 304
 Laricis (Jacq.) Murrill, 204
 pinicola (Schw.) Cooke, 203
 pomaceus (Pers.) Lloyd, 284
 populinus Fr., 303
 roseus (Alb. & Schw.) Fr., 202, 203
 ulmarius (Sow.) Fr., 305
Forsythia suspensa, 291
Fragaria (strawberry), 16, 17, 18, 19, 63, 65, 77, 96, 268, 286, 313
 chiloensis, 18
 virginiana, 18
Fragaria Virus 1 K. M. Smith, 286
Fragaria Virus 2 K. M. Smith, 286
Fraxinus (ash), 57, 92, 128, 140, 171, 301, 316
Freesia, 93
Fuligo Haller, 86
 septica (Linn.) Weber, 172
Fumago salicina (Pers. ex Fr.) Tul., 427
Fumaria, 84
Fungoides Dill., 220
Fungus Foray, Epping Forest, 4 October 1941, by J. Ramsbottom, 223
Fusarium wilt of runner beans, by D. L. G. Davies, 418
Fusarium Link ex Fr., 63, 88, 103, 104, 195, 217, 219, 256, 271, 281, 286, 287, 291, 293, 298, 305, 342, 398, 401, 413, 418, 421
 aurantiacum (Link) Sacc., 65
 avenaceum (Fr.) Sacc., 286
 Betae (Desm.) Sacc., 65
 bulbigenum Cooke & Massee, 290, 294
 var. *Lycopersici* (Brushi) Wollenw., 278
 caeruleum (Lib.) Sacc., 272
 conglutinans Wollenw., var. *Callistephi* Beach, 288
 culmorum (W. G. Smith) Sacc., 270, 271, 272
 elongatum De Wild., 398, 401, 413
 filisporum (Cooke) Sacc., 64
 foeni (B. & Br.) Sacc., 65
 herbarum (Corda) Fr., var. *avenaceum* (Fr.) Wollenw., 64
 Hordei (W. G. Sm.) Sacc., 66
 incarcerans (Berk.) Sacc., 64
 insidiosum (Berk.) Sacc., 65
 lateritium Nees ex Fr., var. *fructigenum* (Fr.) Wollenw., 65
 Lolii (W. G. Sm.) Sacc., 65

- longissimum Sacc. & Syd., 219, 341, 398,
 413
 lutulatum Sherb., 420
 Martii Appel & Wollenw., var. Pisi
 F. R. Jones, 66
 var. viride Sherb., 66
 merismoides Corda, var. majus Wollenw., 65
 oxysporum Schlecht. ex Fr., f. Lycopersici
 (Sacc.) Snyder & Hansen, 278
 f. Narcissi Snyder & Hansen, 64
 var. resupinatum Sherb., 65
 roseolum (B. & Br.) Sacc., 65
 sambucinum Fuckel, 256, 257
 Scirpi Lamb. & Fautr., var. nigrans Ben-
 nett, 66
 var. pallens Bennett, 66
 Solani Mart., var. Martii (Appel &
 Wollenw.), 279
 udum (Berk.) Fr., 65
 vasinfectum Atk., var. lutulatum (Sherb.)
 Wollenw., 420, 421, 423, 424, 425, 426
 var. niveum Wollenw., 64
 Fusicladium Cerasi (Rabenh.) Sacc., 84, 86
 pirinum (Lib.) Fuckel, var. Pyracanthae
 Thuem., 296
 saliciperduum (All. & Tub.) Tub., 304
 Fusidium Link ex Fr., 71, 72, 94, 103
 Geranii Westend., 94
 Fusisporium Link, 62, 71, 72, 88, 91, 103
 mucophytum W. G. Smith, 66
 obtusum Cooke, 63

 Gagea, 147
 Gaillardia, 291
 Galanthus, 28, 70, 294
 nivalis, 291
 Galium, 147
 Ganoderma applanatum (Pers.) Pat., 301
 lucidum (Leyss) Karst., 304, 430
 Geaster Mich. ex Fr., 434
 Geastrum Pers., 434
 Gentiana, 85
 Macauleyi, 291
 sino-ornata, 291
 Geotrichum candidum Link, 57, 72
 matalense (Castellani) Castellani, var.
 Chapmani Castellani, 72
 Geranium, 95, 96
 Geum, 94
 Ghost flowers, 7
 Gibbera flacca (Wallr.) Phill. & Plowr., 176
 Gibberella baccata (Wallr.) Sacc., 65
 Buxi (Fuckel) Wint., 177
 cyanogena (Desm.) Sacc., 176
 flacca Wallr., 176
 flacca (Wallr.) Sacc., 176, 177
 moricola Ces. & de Not., 176
 pulicaris (Fr.) Sacc., 66, 176, 177, 256, 257
 Saubinetii (Mont.) Sacc., 65, 270
 Zeae (Schw.) Petch, 65, 177
 Gibellula Cav., 264
 Gibsonia phaeospora Masee, 168
 Ginkgo (Salisburia), 88
 Gladiolus, 28, 66, 70, 102, 291, 434
 Glenodinium cinctum, 47
 Gliocladium Corda, 54, 263
 roseum (Link ex Fr.) Bainier, 55, 61
 Gloeosporium Desm. & Mont., 294, 334, 431,
 432
 Begoniae Magn., 288
 cingulatum Atk., 432
 concentricum (Grev.) B. & Br., 273, 280
 Cytisi B. & Br., 292
 elasticum Cooke & Masee, 291
 Frankii Allesch., 334
 fructigenum Berk., 283, 431
 laeticolor Berk., 431
 Nicolai Aggéry, 334
 Nymphaearum Allesch., 294
 piperatum Ell. & Everh., 432
 Platani (Mont.) Oudem., 57
 Polypodii Aggéry, 334
 Ribis (Lib.) Mont. & Desm., 21
 rufomaculans (Berk.) Thuem., 432
 Salicis Westend., 304
 venetum Speg., 17
 versicolor Berk. & Curt., 432
 Violae B. & Br., 299
 Gloeosporium Nicolai Aggéry and Gloeosporium
 Polypodii Aggéry, by J. Ramsbottom, 334
 Glomerella Spauld. & v. Schrenk, 432
 cingulata (Stonem.) Spauld. & v. Schrenk,
 283, 284, 432
 fructigena (Clint.) Sacc., 432
 phacidomorpha (Ces.) Petr., 295
 rufomaculans (Stonem.) Spauld. & v.
 Schrenk, 432
 Gloniopsis de Not., 130, 131, 132, 133, 134,
 135, 139
 biformis (Fr.) Sacc., 131, 133, 134
 curvata (Fr.) Sacc., 129, 131, 132, 133, 139,
 140
 decipiens de Not., 134
 f. Pini Roum., 134
 Gerardiana Sacc., 131
 levantica Rehm, 129, 132, 134, 139, 140
 Muellieri (Duby) Sacc., 134
 Vaccinii (Carm. ex Berk.) Boughey, 134
 Watsoni Rilstone, 135, 139
 Gloxinia speciosa, 292
 Glyceria, 147
 aquatica, 275
 fluitans, 275
 Gnomonia leptostyla (Fr.) Ces. & de Not., 287
 veneta (Sacc. & Speg.) Kleb., 300
 Gnomonia Leaf Scorch of cherry, 268
 Gnomoniella Coryli (Batsch) Sacc., 300
 Gnomoniopsis Berl., 432
 Gnomoniopsis Stonem., 432
 cingulata Stonem., 432
 fructigena Clint., 432
 piperata Stonem., 432
 Godetia, 215, 292
 Gonapodya Fisch., 320
 prolifera (Cornu) Fisch., 320, 324, 325
 Graphium Corda, 55, 73, 75
 calicioides Cooke & Masee, 55, 58
 subulatum (Nees ex Fr.) Sacc., 56, 104
 Gray, E. G., 'Phialea mucosa sp. nov., the Blind-
 seed fungus', 329
 Gregory, P. H., 'Studies on Sclerotinia and
 Botrytis. I', 26
 'Dissemination of fungus spores in air', 442
 Grey Mould of Narcissus, 35

- Griphosphaeria corticola (Fuckel) v. Hoehn., 297
 Gryllotalpa (mole cricket), 254, 255
 Guignardia Buxi Desm., 288
 Gymnopus Roussel, 430
 Gymnosporangium clavariaeforme (Jacq.) DC., 301
 Juniperi Link, 301, 304
 Gymnosporium B. & Br., 71, 77
 Gymnostachyum, 91
 Gynerium, 55

 Haddow, W. R., 'On the history and diagnosis of *Polyporus tomentosus* Fries, *Polyporus circinatus* Fries and *Polyporus dualis* Peck', 179
 Hadrotrichum virescens Sacc. & Roum., 276
 Halo Blight of dwarf beans, 216
 Halotydeus destructor, 250
 Hanseniospora Zikes, 437
 Haplographium B. & Br., 73, 103
 chlorocephalum (Fres.) Grove, 73
 Harpochytrium Lagerh., 43
 Hedinii Wille, 43
 Helenium, 209, 210
 autumnale, 210
 Hoopesii, 210
 Helianthus, 292
 tuberosus (Jerusalem artichoke), 282
 Helicobasidium Pat., 429, 433, 437
 purpureum (Tul.) Pat., 102, 268, 272, 278, 302, 433
 Helicobasis Clem., 429
 Helicocoryne viridis Corda, 101
 Helicosporium pulvinatum Nees ex Fr., var. effusum Berk., 100
 Heliscus Sacc., 359, 413
 *aquaticus Ingold, n.sp., 340, 357, 358, 359, 360, 362, 410, 411, 412, 413, 415, 417
 *longibrachiatus Ingold, n.sp., 340, 360, 361, 362, 413, 416
 lugdunensis Sacc. & Therry, 359, 362
 Helleborus, 95
 niger (Christmas rose), 292
 Helminthosphaeria Fuckel, 87
 Helminthosporium Link, 75, 87, 88, 91, 93
 fumosum (Corda) Currey, 90
 gramineum Rabenh., 271
 inconspicuum Cooke & Massee, var. britannicum Grove, 91
 obclavatum Sacc., 91, 92
 rhabdiferum (Berk.) Sacc., 90, 92
 sativum Pamm. King & Bakke, 270
 siccans Drechsl., 274, 427
 teres Sacc., 271
 Tiliae Fr., 91, 92
 vagans Drechsl., 275, 427
 variabile Cooke, 93
 velutinum Link ex Fr., 91, 92
 Helotium Fr., 329, 330
 carpinicola Rehm, 330
 conformatum Karst., 330
 epiphyllum Fr., 330
 fructigenum Karst., 330
 herbarum Fr., 329, 330
 pallescent (Pers.) Fr., 330

 Helvella Linn., 427
 infula Schaeff., 167
 Hemerocallis, 93
 Hendersonia Grossulariae Oudem., 285
 Heracleum, 82, 95
 Hesperis matronalis, 280
 Heterobasidium Mass., 431
 Heterodera marioni, 279
 schachtii, 272, 274, 279
 Heteropatella Antirrhini Buddin & Wakefield, 269
 valtellinensis (Trav.) Wollenw., 290
 Heterosporium Klotz., ex Cooke, 84, 92
 Allii Ellis & Martin, var. cepivorum Nicolas & Aggery, 92
 echinulatum (Berk.) Cooke, 92, 93
 exasperatum (B. & Br.) Cooke, 92
 gracile Sacc., 291
 Phragmitis (Opiz) Sacc., var. typharum nom. nud., 93
 Hieracium sylvaticum, 288
 vulgatum, 288
 Hippeastrum, 292
 Hirsutella Pat., 59, 257, 259, 264, 265
 Eleutheratorum (Nees) Petch, 265, 306
 entomophila Pat., 258
 floccosa Speare, 257
 Holcus, 147, 276, 277
 Hordeum (barley), 66, 73, 87, 91, 92, 147, 216, 217, 218, 271
 murinum, 217
 Hormiscium Kunze ex Wallr., 90
 hysterioides (Corda) Sacc., 98
 pithyophilum Sacc., var. myrmecophilum Bayl. Ell., 73
 Hormodendron Bon., 246
 Hordei Bruhne, var. parvispora A.L. Smith, 73
 Humulus Lupulus (hop), 17, 75, 77, 89, 93, 305, 440
 Hyacinthus (hyacinth), 28, 70, 76, 78, 215, 421
 orientalis, 292
 Hyalodendron album (Dowson) Diddens, 435
 Hyalopycnis v. Hoehn., 166
 blepharistoma (Berk.) v. Hoehn., 166
 hyalina v. Hoehn., 166
 vitrea (Corda) v. Hoehn., 166
 Hydrangea hortensis, 292
 Hygrophorus Fr., 61
 Hymenostilbe Petch, 259
 *Aphidis Petch, n.sp., 259
 sphecophila (Ditm.) Petch, 178
 Hymenula Fr., 56, 66
 Hypericum calycinum, 70
 Hypholoma fasciculare (Huds.) Fr., 223
 Hyphomycetes, British, List of, 49
 Hyphonectria Raciborskii Penz. & Sacc., 172
 Solani (Reinke & Berth.) Petch, 171
 violacea (Schmidt) Petch, 172
 Hypnum, 55
 Hypochaeris, 95
 radicata, 281
 Hypochanum Kalchbr., 335, 336
 Hypochnus Tul., 431, 437
 purpureus Tul., 433
 Hypocrea gelatinosa (Fr.) Fr., 60
 rufa (Fr.) Fr., 60

- Hypoderma brachysporum* (Rostr.) Tul., 302
Desmazierii Duby, 302
pinicola Brunch., 303
strobicola Tubeuf, 302
Hypolyssus Pers., 431
Hypomyces Tul., 72, 86, 431
asterophorus Tul., 79
aurantius (Fr.) Tul., 85, 172
aureonitens Tul., 54
Broomeanus Tul., 55
candicans Plowr., 172
exiguus Pat., 172
ochraceus Tul., 60, 61, 103
rosellus (Alb. & Schw.) Tul., 90
terrestris Plowr. & Boud., 61
violaceus (Schmidt) Tul., 86
Hypospila Fr., 431
Hypoxyton coccineum Bull., 74
Hysterium (Tode) Fr. em. Sacc., 127, 139, 434
acuminatum Fr. sensu Rehm, 129, 130, 139
aggregatum DC., 138
alneum (Ach.) Rehm, 128
angustatum (Alb. & Schw. ex Fr.) Chev., 128, 129, 130, 133, 139, 140
biforme Fr., 133
curvatum Fr., 132
elongatum Wahlenb., ex Fr., var. *curvatum* Fr., 131
insidens Schw., 139
Muelleri Duby, 134
naviculare Wallr., 132
pulicare Pers. ex Fr., 127, 128, 129, 130, 131, 133, 139
Vaccinii Carm. ex Berk., 134
Vaccinii Schwein., 134
Hystero-graphium Corda, 133, 134
Dubyi Hilitzer, 133
var. *acuminatum* Hilitzer, 133
elongatum (Wahlenb. ex Fr.) Corda, 133
Hysteropycnis Hilitzer, 128, 139
admixta Hilitzer, 131
occulta Hilitzer, 128
Ilex, 92
Aquifolium (holly), 63, 101
Index to list of British Hyphomycetes, 111
Ingold, C. T., 'Studies on British Chytrids.
I. *Phlyctocytrium proliferum* sp.nov., and
Rhizophidium Lecythii sp.nov.', 41
'Tetracladium-like fungi from a stream in
Leicestershire', 219
'Aquatic hyphomycetes of decaying alder
leaves', 339
'Aquatic hyphomycetes of decaying oak
leaves', 441
Instructions for preparing 'Copy', setting
type and reading proofs, 211
Iris, 70, 93, 99, 101, 196, 197, 199, 292
Isaria Pers., 69, 73, 74, 298
arachnophila Ditm., 306
arbuscula Hariot, 252
acaricida Pat., 260
Cicadae Mig., 252, 253, 254
dubia Delacr., 261
farinosa Fr., 74, 81, 250, 260, 261, 306
floccosa Fr., 56
leprosa Fr., 74, 81
ochracea Boud., 261
orthopterorum Petch, 260
*(*Beauveria*) *sphaerocephala* Petch, n.sp.,
260
Sphingum Schw., 68
tenuipes Petch, 260, 261
Sinclairii (Berk.) Lloyd, 252, 253, 254
umbrina Pers. ex Wallr., 28
Isatis (woad), 427
Isomyces Clem., 437
Ixia, 28
Jasminum, 76
Juglans (walnut), 62, 85, 287
Juncus, 58, 61, 103
Juniperus communis, 301
Kabatiella caulivora (Kirchn.) Karak., 274
Kalchbrennera Berk., 335, 336
Keithia tetraspora (Phill. & Keith) Sacc., 301
thujina Durand, 304
Tsugae (Farl.) Durand, 305
Keyworth, W. G., 'The occurrence in arti-
ficial culture of tremelloid outgrowths on
the pilei of *Coprinus ephemerus*', 307
'*Verticillium* wilt of hops', 440
Kneiffia Fr., 429
Kneiffia Spach, 429
Kniphofia, 85
Labrella Coryli (Rabenh.) Sacc., 300
Laburnum, 86, 175, 176, 292
Laccaria laccata (Scop.) B. & Br., 307
Lachnaea Linn., 429
Lachnea Fr., 70
Lachnea Gill., 428
Lachnosterna quercina, 250
Lactarius Fr., 60, 78, 99, 224
Lactuca (lettuce), 63, 216, 281
Lactuca Virus 1 K. M. Smith, 281
Laminaria, 72, 75, 81, 84, 97, 99
Lamium, 77, 95
Lanarkshire Disease of strawberry, 17, 18
Lapsana, 95
Large, E. C., 'Sketches of the growth of the
potato from planting to harvest, with
special reference to humus deficiency',
337
Larix, 74, 90, 93, 100, 129, 130, 137
europaea, 301
leptolepis, 301
occidentalis, 301
Lasionectria lecanodes (Ces.) Petch, 171
Leptosphaeria (Niessl) Petch, 66, 171
Latania borbonica, 170
Lathyrus, 73, 76, 93
macrorrhizus, 279
odoratus (sweet pea), 292, 293, 313, 421,
425
pratensis, 280
Lavandula, 293
Leaf Roll of potato, 272
Leaf Scorch, 6, 7
Leaf Spot of oats, 216
Leaf Stripe of barley, 216
Lecythium hyalinum, 45, 47
Lembosia, 296

- Lemonniera De Wild., 352, 413
 aquatica De Wild., 340, 341, 343, 344, 345,
 346, 347, 350, 351, 363, 380, 411, 413,
 415, 417
 Lentinus adhaerens (Alb. & Schw.) Fr., 305
 cochleatus (Pers.) Fr., 201
 lepideus Fr., 201, 203, 204, 305
 tigrinus (Bull.) Fr., 201
 Lenzites saepiaria (Wulf) Fr., 305
 trabea (Pers.) Fr., 201
 Leocarpus fragilis Rost., 61
 Lepidium (cress), 282
 Lepiota cepaestipes (Sow.) Quél., 102
 meleagris (Sow. ex Berk.) Quél., 101
 Leptographium Lundbergii Lagerh. & Melin,
 55
 Leptosphaeria Coniothyrium (Fuckel) Sacc.,
 285, 286, 297
 doliolum (Pers.) Ces. & de Not., 66, 171
 Leptothyrium alneum Sacc., 300
 gentianaeecolum Bauml., 291
 Letendrea Sacc., 168
 Libertella salicina (Corda) Wollenw., 66
 Ligustrum (privet), 131, 293, 432
 Lilium (lily), 63, 70, 196, 197, 199, 293
 aurantiacum, 293
 auratum, 293
 Brownii, 293
 candidum, 293
 centrifolium, 293
 chalcedonicum, 293
 dauricum, 293
 formosum, 293
 Hansonii, 293
 Martagon, 293
 melpomene, 293
 pardalinum, 293
 platyphyllum, 293
 regale, 197, 293
 sargentia, 293
 Szovitsianum, 293
 testaceum, 293
 tigrinum, 293
 Lilium Virus 1 K. M. Smith, 293
 Linaria, 147
 Lindbladia Fr., 59
 Linum (flax), 53, 65, 305
 catharticum, 305
 Liriodendron tulipifera, 302
 List of diseases of economic plants recorded in
 Scotland, by R. W. G. Dennis and C. E.
 Foister, 266
 List of Hyphomycetes recorded for Britain, by
 E. M. Wakefield and G. R. Bisby, 49,
 427
 List of Members, 443
 Lochmaea suturalis (heath beetle), 289, 305
 Lolium (rye grass), 53, 147, 274, 427
 multiflorum, 332
 perenne, 332
 temulentum, 277, 332
 Loniceria, 131
 Loose smut, 217, 218
 Lophium Fr., 136
 aggregatum (DC.) Fr., 138
 fusisporum Cooke, 137
 mytilinum (Pers.) Fr., 137
 Lophodermellina macrospora (Hartig) Tehon,
 302
 Lophodermium melaleucum Fr., 296
 Pinastri (Schr.) Chev., 302, 303
 Lotus, 76, 77, 96
 *Lunulospora Ingold, n.gen., 391, 408, 409,
 412, 413
 *curvula Ingold, n.sp., 340, 404, 405, 406,
 407, 408, 411, 413, 417
 Lupinus, 88, 293
 Lychnis, 85, 95
 alba, 291
 dioica, 291
 Flos-cuculi, 291
 Lycoperdon (Tourn.) Pers., 298, 434
 acariforme Sow., 74
 graniforme Sow., 126
 Lycopersicum (tomato): see Solanum Lyco-
 persicum
 Lycopersicum Virus 1 K. M. Smith, 278
 Lycopersicum Virus 3 K. M. Smith, 278, 288,
 289, 290, 292, 296
 Lycopodium, 59
 Lysimachia, 95
 Lysurus Tuckii MacOwan, 336

 MacOwania Kalchbr., 336
 Macowania, Hypochaerum or Macowanites? by
 J. Ramsbottom, 335
 Macowania Kalchbr., 335, 336
 MacOwanites Kalchbr., 335
 Macowanites Kalchbr., 335, 336
 agaricus Kalchbr., 336
 Macrophoma Berl. & Vogl., 291
 cylindrospora Berl. & Vogl., 296
 Phaseoli (Maubl.) Ashby, 287
 Macrosporium Fr., 91, 92, 97, 98, 99
 Brassicae Berk., 97
 Cheiranthe (Libert) Fr., 98
 var. Betae Cooke, 98
 commune Rabenh., 98, 100, 280
 Cookei Sacc., 98, 99
 Solani Cooke, 98
 Tomato Cooke, 98
 Magnolia, 84
 Mahonia aquifolia, 293
 Malva moschata, 95
 Manganese deficiency, 271, 273, 279, 338
 Marasmius Fr., 436
 *Margaritispora Ingold, n.gen., 352, 413
 *aquatica Ingold, n.sp., 340, 347, 348, 349,
 350, 351, 352, 353, 410, 411, 413, 415,
 417
 Marginal Spot of lettuce, 216
 Marssonina Fisch., 87, 429
 Marssonina Karst., 429
 Marssonina Fragariae (Sacc.) Kleb., 286
 Panattoniana (Berk.) Magn., 281
 Populi Magn., 303
 Mason, E. W., 'New species and old', 433, 441
 Mastigosporium album Riess, 275
 var. muticum Sacc., 67
 rubricosum (Dearn. & Barth.) Sprague, 276
 Matthiola, 293
 Maxillospora maxilliformis (Rostr.) v. Hoehn.,
 372
 Mayeticola destructor (Hessian fly), 217

- Meconopsis*, 293, 294
Wallichii, 293
Medicago Lupulina, 274
sativa (lucerne), 313
Melaleuca vulgaris Pat., 436
Melampsora Cast., 301, 304
Allii-populina Kleb., 303
Larici-populina Kleb., 303
Larici-tremulae Kleb., 303
Lini Desm., 305
Rostrupii Wagner, 303
Melampsorella Caryophyllacearum Schroet., 299
Melampsoridium Alni Diet., 300
betulinum Kleb., 300
Melanconium Link, 77
Melanoleuca Pat., 436
**melaleuca* (Pers. ex Fr.) Ramsb., n.comb., 436
vulgaris (Pat.) Pat., 436
Melanospora Corda, 166, 167
cirrhatta Berk., 167, 168
vitrea (Corda) Sacc., 166
Zamia Corda, 167, 168
Melanotaenium cingens (Berk.) Magn., 147
endogenum (Unger) de Bary, 147
Meliola Fr., 141
Melogramma Tul., 135
Melolontha (cockchafer), 250, 251
Mentha (mint), 95, 282
Mercurialis, 69, 89
Meria Laricis Vuill., 301
Merulius Fr., 202
himantoides Fr., 201
lacrymans (Wulf) Fr., 201, 202, 204, 205, 305
serpens (Tode) Fr., 201
Metarrhizium Anisopliae (Metsch.) Sor., 306
Microcera Desm., 257
tasmaniensis McAlp., 256
Micrococcus dendroorthos Ludw., 14
Microsphaera Berberidis (DC.) Lév., 288
Grossulariae (Wallr.) Lév., 285
polonica Siemaszko, 292
quercina (Schw.) Burr., 304
Microsporium lanosum, 380, 401
Milesia Polypodii B. White, 334
(Milesina) Scolopendrii (Fuckel) Arth., 334
Whitei Faull., 334
Milesina Dieteliana Syd., 334
Kriegeriana P. Magn., 291, 299
Milowia Masee, 63, 104
nivea Masee, 63
Mineral deficiency, 338
Molinia caerulea, 277
Monilia Pers. em. Sacc., 21, 58, 68, 80, 342
cinerea Bon., 5, 11, 12, 20
fasciculata Corda, 71
fructigena Pers., 5, 11, 12
glasti Plowr., 75, 427
humicola Oudem., var. *brunnea* A. L. Smith, 75
penicillata Fr., 71
Monotospora Corda, 75, 88
megalospora B. & Br., 138
var. *fusispora* Sacc., 75
Moore, W. C., 'New and interesting plant diseases', 206
'Presidential Address: Organization for Plant Pathology in England and Wales—Retrospect and prospect', 229
Morchella Dill., 220
Morus, 65, 89, 90, 91
Mosaic diseases, 18, 19
Mucilago spongiosa (Leyss) Morgan, 293, 298
Mucor (Mich.) Link, 441
Mucor Botrytis Bolt., 71
caespitosus Bolt., 75
caseus With., 63
hiemalis Wehmer, 441
hyalinus Cooke, 55
plasmaticus v. Tiegh., 442
racemosus Fres., 441
Rouxianus (Calmette) Wehmer, 441
Mucronoporus Ell. & Everh., 182, 185
circinatus (Fr.) Ell. & Everh., 182, 183, 185
Musa (banana), 421
Musca domestica (house fly), 305
Muscari polyanthum, 294
Mycena Fr., 54, 61
crocata (Schrad.) Fr., 326
Mycodendron Mass., 431
Mycogone Link, 342
perniciosa Magn., 282
puccinioides (Preuss) Sacc., 103
Mycological nomenclature, discussion on, 428, 441
Mycorhynchus Sacc., 173, 174
Marchalii (Sacc.) Sacc. & D. Sacc., 174
Mycosphaerella brassicicola (Fr.) Lind., 280
Fragariae (Tul.) Lind., 96, 286
pinodes (Berk. & Blox.) Vestergr., 279
Ribis (Fuckel) Kleb., 285
Mycosyrinx Beck, 144
Myosotis (forget-me-not), 294
arvensis, 294
caespitosa, 294
palustris, 294
versicolor, 294
Myriadoporus Peck, 431
Myrica Gale, 76, 77
Myrtus (myrtle), 89, 294
Myxosporium adustum Mass., 292
Mytilidion Duby, 136, 137, 138, 139
aggregatum (DC. ex Fr.) Duby, 138
decipiens (Karst.) Sacc., 136, 137
fusisporum (Cooke) Sacc., 137
gemmigenum Fuckel, 129, 137, 139
Karstenii Sacc., 129, 137, 138, 139, 140
laeviusculum (Karst.) Sacc., 129, 136, 137, 139
rhenanum Fuckel, 138
scolecosporum Lohman, 138
Myxosporium scutellatum (Oth) Petr., 304
Myxotrichum Kunze, 55
Nailhead Spot of tomato, 98
Narcissus, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 63, 64, 65, 70, 78, 93, 96, 294
poeticus, 36
pseudonarcissus, 32, 34, 36
Tazetta, 29, 32, 34
Narcissus Fire, 29, 31, 33, 34, 35

- Nardus stricta*, 277
Narthecium, 93
Nasturtium officinale (water cress), 282
Nectria Fr., 53, 57, 170, 175, 178
 applanata Fuckel, 170
 cinnabarina (Fr.) Fr., 60, 168, 251, 283, 284, 285, 300
 coccinea (Pers.) Fr., 62, 168
 ditissima Tul., 8, 14, 168
 episphaeria (Tode ex Fr.) Fr., 63
 var. *coronata* Wollenw., 63
 galligena Bres., 8, 63, 283, 301
 haematococca B. & Br., 170
 Hippocastani Allesch., 169
 inundata Rehm ap. Weese, 168
 inventa Pethybr., 53
 Magnusiana Rehm, 54
 mammoidea Phill. & Plowr. var. *Rubi* (Osterw.) Weese, 285
 ochroleuca (Schw.) Berk., 61, 169
 **polyporina* Petch, n.sp., 169
 Rexiana Ellis, 172
 Rousselliana Mont., 435
 Solani Reinke & Berth., 66
Nectriella Nits., 175
 chrysites (Westend.) Sacc., 171
 Robergei (Mont. & Desm.) Weese, 57
 Sambuci (v. Hoehn.) Weese, 175
Nematospora Gossypii Ash. & Nowell, 437
Nemesia, 294
Neobarclaya Sacc., 429
Neovossia Koern., 145
Nepeta, 54
Neurospora Shear & Dodge, 75
 New and interesting plant diseases, by W. C. Moore, 206
 New methods for the cultivation of wood-rotting fungi, by E. C. Badcock, 200
Nicotiana (tobacco), 78
Nicotiana Virus 1 K. M. Smith, 278
 Nomenclature, discussion on, 337
 Notes on Entomogenous fungi, by T. Petch, 250
Nuphar, 95, 151
Nyctalis asterophora Fr., 101, 103
Nymphaea (water lily), 95, 151, 294

 Occurrence in artificial culture of tremelloid outgrowths on the pilei of *Coprinus ephemerus*, by W. G. Keyworth, 307
Odontoglossum, 89
Oedocephalum Preuss., 76, 80
Oidium Link, 55, 57, 58, 72, 75, 290, 292, 298
 aequivocum (Corda) B. & Br., 57
 Chrysanthemi Rabenh., 289
 Lupuli Matt. & Lott., 75
 Oxalidis McAlp., 294
Oligonychus ulmi, 338
Olpidium radicum De Wildem., 273
 On the generic name of the bacterial plant pathogens, by W. J. Dowson, 311
 On the numbers of fungi, by G. R. Bisby and G. C. Ainsworth, 219
Oncidium, 57, 90
Onnia Karst., 182, 183
 tomentosa (Fr.) Karst., 182
Ononis, 96

Oospora Wallr., 82, 300
 aurantia (Cooke) Sacc. & Vogl., 75
 fusca (Bon.) Grove, 82
 lactis (Fres.) Sacc., 57, 72, 305
 Lupuli (Matt. & Lott.) Lind., 75
 pustulans Owen & Wakefield, 272
Ophiobolus graminis Sacc., 217, 268, 270, 271
 var. *Avenae* E. M. Turner, 218, 271
Ophiocordyceps clavulata (Schw.) Petch, 56
 **Gryllotalpae* (Kobayasi) Petch, n.comb., 255
Ophionectria Briardi Boud., 178
 cerea (Berk. & Curt.) Ell. & Everh., 177
 episphaeria Karst., 178
 Everhartii Ell. & Galw., 178
Ophiopogon, 87
Ophiostoma Piceae (Münch) Syd., 55
 * *Ulmi* (Buism.) Nannf., 56
Ornithogalum, 93
Orthotrichum, 64
Ostrechnion Duby, 429
Ostreion Sacc., 429
Ovosphaerella Lapathi Laibach, 77
Ovularia Sacc., 70, 76, 94, 95, 96, 208, 209
 destructiva (Phill. & Plowr.) Massee, 76, 77
 interstitialis (B. & Br.) Massee, 76, 77, 209
 latea (Desm.) Bomm. & Rouss., 95
 primulana Karst., 76, 77, 209, 295
 Syringae Berk., 297
Oxalis, 89
 corniculatus, 294
 rosea, 294
Oxyria, 147

Pachnocybe Berk., 55, 56, 59, 104
 albida (Fr.) Berk., 74
Pachybasium hamatum (Bon.) Sacc., var. *candidum* Sacc., 77
Paecilomyces Bain., 77, 81
Paeonia, 70, 85, 294
Palmella, 57
Papaver dubium, 295
 somniferum, 295
Papularia Fr., 71, 77
Papulaspora Preuss., 429, 434, 438
 Dodge Connors, 438
 Gladioli (Requien) Dodge & Laskaris, 434, 438, 441
 Gladioli H. H. Hots., 438
Parietaria, 95
Passalora Fr. & Mont., 86, 87
Pastinaca (parsnip), 89, 95, 282
Peach, bacterial canker of, by H. Wormald, 246
Pedicularis, 95
Pediospora dactylopa Drechs., 412
Pelargonium, 66
 zonale, 295
Pelargonium Virus 1 K. M. Smith, 295
Peltigera Willd., 57
 polydactyla Hoffm., 171
Pelvetia, 72, 99
Penicillium Link, 31, 55, 56, 71, 73, 194, 195, 196, 197, 198, 199, 207, 208, 224, 292, 294, 298, 342, 347, 352, 441
 brevi-compactum Dierckx, 224
 candidum Link ex Fr., var. *Coremium* Cooke, 77
 corymbiferum Westling, 196, 197, 291, 292

- cyclopium Westling, 196, 197, 224, 297
 digitatum Sacc., 287
 expansum Thom., 283
 Gladioli McCulloch, 291
 italicum Wehmer, 287
 roseum Corda, 55
 stolonifera Thom., 224
 Thomii Maire, 206, 208, 210, 427
 Peniophora Cooke, 101
 candida Lyman, 67
 Periconia Sacc., 55, 58, 75, 79
 calycioides (Fr.) Berk., 55, 58
 Peridermium Laricis (Kleb.) Arth., 301
 Pini Chev., 303
 Peronospora Corda, 76, 77
 arborescens (Berk.) de Bary, 294, 295
 candida Fuckel, 295
 interstitialis B. & Br., 209
 Matthiolae Gäum., 293
 Myosotidis de Bary, 294
 Oerteliana Kuehn, 209, 295
 parasitica (Pers.) Tul., 268, 273, 282, 289, 435
 Schachtii Fuckel, 435
 Schleideniana W. G. Smith, 281
 Trifoliorum de Bary, 274
 Viciae (Berk.) de Bary, 279, 293
 Violae de Bary, 298
 Pestalotia de Not., 304, 429, 431
 Pestalozzia Corda, 429, 431
 Petasites, 96
 japonicus, 295
 palmaris, 295
 Petch, T., 'Further notes on British Hypocreales', 166
 'Notes on entomogenous fungi', 250
 Petroselinum segetum (parsley), 282
 Petunia, 95, 295
 Peziza Dill., 220
 Peziza Fr., 88
 Pezizella Lythri (Desm.) Shear & Dodge, 286
 Phaeoisaria v. Hoehn., 55, 79
 Phalaris, 84
 Phallus Micheli, 220
 Phaseolus, 66, 216, 313, 418, 422, 423, 425
 multiflorus (runner bean), 280, 425
 vulgaris (dwarf bean), 280
 Phaseolus Virus 1 K. M. Smith, 280
 Phellinus cryptarum Karst., 201, 203, 204
 Phialea Fr., 329, 330
 cyathoidea (Fr.) Gill., 330
 *mucosa E. G. Gray, n.sp., 329, 331, 332
 strobilina Sacc., 330
 Phialea mucosa sp.nov., the blind-seed fungus,
 by E. G. Gray, 329
 Phialophora Thaxt., 61
 Philadelphus coronarius, 295
 Philodendron, 60
 Phleospora Aceris Sacc., 300
 Oxyacanthae (Kunze & Schmidt) Wallr., 301
 Phleum pratense, 275
 Phlox, 295
 Phlyctochytrium chaetiferum Karling, 43
 *proliferum C. T. Ingold, n.sp., 41, 42, 43,
 44, 45, 47
 Spirogyrae De Wildem., 43
 Phoenix, 81
 Pholiota adiposa Fr., 301
 Phoma Fr. em. Desm., 285, 299
 Acridii Tassi, 258
 alicola Speg., 258
 apicola Kleb., 282
 Betae (Oud.) Frank, 273, 282
 destructiva Plowr., 278
 foveata Foister, 272
 Lavandulae Gabot, 293
 lingam (Tode) Desm., 273, 280, 293
 Mali Schulz & Sacc., 98
 (?) Phlogis Roum., 295
 pithya Sacc., 303
 Rhodora Cooke, 296
 Phomopsis Sacc., 304
 controversa (Sacc.) Trav., 301
 Pseudotsugae Wilson, 300, 301, 303, 305
 pungens Grove, 285
 scobina (Cooke) v. Hoehn., 301
 Phormium tenax, 295
 Phragmidium mucronatum (Pers.) Schlecht.,
 297
 Rubi-Idaei (Pers.) Karst., 286
 Phragmites, 93, 177
 Phycastrium longispinum, 383
 Phylacteria terrestris (Ehrh.) Big. & Guill., 302
 Phyllachora graminis (Pers.) Fuckel, 275, 276, 277
 sylvatica Sacc. & Speg., 275
 Phyllactinia corylea (Pers.) Karst., 300
 Phyllitis, 96
 Phyllophaga anxia, 263
 Phyllosticta Pers., 20, 283, 284, 289, 296
 Ajacis Thuem., 290
 angulata Wenzl, 20
 Antirrhini Syd., 287
 atrozonata Voss., 292
 Begoniae Brun., 288
 Berlesiana Allesch., 258
 Briardi Sacc., 283
 carpathica Allesch. & Syd., 289
 Cytisi Desm., 292
 dahlicola Brun., 290
 Forsythiae Sacc., 291
 Grossulariae Sacc., 285
 Ligustri Sacc., 293
 Mahoniae Sacc. & Speg., 293
 mahoniana (Sacc.) Allesch., 293
 primulicola Desm., 295
 Rhododendri Westend., 296
 Richardiae Halsted, 296
 solitaria Ell. & Everh., 283
 Sorbi Westend., 304
 Syringae Westend., 297
 Violae Desm., 299
 Physalospora Niessl, 304
 gregaria Sacc., var. foliorum Sacc., 304
 Miyabeana Fukushi, 304
 obtusata (Schw.) Cooke, 283
 Physarum Pers., 61
 didermoides (Ach.) Rost., 172
 Physcia (Ach.) Wain., 71
 Phytomonas Bergey, 311
 fascians Tilford, 311, 312
 flaccumfaciens (Hedg.) Bergey, 311, 312
 insidiosa (McCulloch) Bergey, 311, 312
 michiganensis (E. F. Smith) Bergey, 311, 312
 Rathayi (E. F. Smith) Bergey, 311
 sepedonica (Spieckermann) Magrou, 311

- Phytopathological excursion, 1942, 442
 Phytopathological observations in Australia and
 New Zealand, 1939, by F. T. Brooks, 215
Phytophthora de Bary, 17, 148, 149, 150, 151,
 152, 153, 154, 155, 156, 158, 159, 160,
 161, 219, 287, 288, 295, 296, 316, 317,
 322, 323, 324, 340, 410
Cactorum (Leb. & Cohn) Schroet., 148,
 268, 290, 292, 293, 296, 298
 var. *applanata* Chester, 285, 295
cambivora (Petri) Buism., 152, 153, 159,
 162, 323
Cinnamomi Rands, 153, 159, 162, 323
cryptogea Pethybr. & Laff., 148, 149, 153,
 159, 160, 161, 162, 278, 288, 292, 293,
 295, 297, 298, 299, 323
Drechsleri Tucker, 159, 162, 323
erythroseptica Pethybr., 162, 272, 298, 323
 var. *Atropae* Alcock, 288
Faberi Maubl., 256
Fragariae C. J. Hickman, 18, 153, 155, 156,
 159, 162, 286, 323
gonapodyides (Petersen) Kanouse, 152
infestans (Mont.) de Bary, 268, 272, 278,
 337, 435
megasperma Drechsl., 149, 153, 156, 158,
 159, 160, 161, 162, 219, 323
parasitica Dastur, 148, 278, 287, 288, 290,
 294, 295
Porri Foister, 281, 323
Richardiae Buism., 153, 154, 159, 162, 323
Syringae (Kleb.) Kleb., 77, 283, 297
verrucosa Alcock & Foister, 278, 294, 295
Picea (spruce), 181, 187, 188, 201, 203, 205
alba, 302
canadensis, 187, 188
excelsa, 299, 302
mariana, 188
nigra, 302
orientalis, 302
pungens, 302
pungens argentea, 302
rubra, 188
Schrenkiana, 302
sitchensis, 302
Picris, 95
Piggotia astroidea B. & Br., 305
Pilacre Petersii Berk. & Curt., 223
Pilobolus Tode ex Fr., 86
crystallinus (Wigg.) Tode, 435
Pinus (pine), 56, 58, 60, 70, 83, 92, 96, 129,
 130, 134, 136, 137, 140, 200, 359
austriaca, 302
Ayacahuite, 302
Cembra, 302
excelsa, 302
flexilis, 302
Lambertiana, 302
Laricio, 302
montana, 302
monticola, 302
parviflora, 302
pungens, 188
resinosa, 188
rigida, 188
Strobus, 187, 188, 302
sylvestris, 303
Pionnotes Betae (Desm.) Sacc., 65
Biasolletiana Corda, 65
uda (Berk.) Sacc., 65
Piptcephalis Fres., 441
Pisum (pea), 66, 79, 85
sativum, 279, 425
Pisum Virus 2 K. M. Smith, 279
Plantago, 73, 95
major, 95
Plasmodiophora Brassicae Woron., 273, 280,
 281, 289
Plasmopara pygmaea (Unger) Schroet., 70
Pleolpidium Blastocladiae v. Minden, 317, 324
inflatum Butler, 317, 322
Pleonectria Sacc., 178
Lamyii (Desm.) Sacc., 178
Pleospora herbarum (Fr.) Rabenh., 100
Pelvetiae Sutherland, 99
pomorum Horne, 21
Plowrightia ribesia (Pers.) Sacc., 285
Plum Rust, 268
Poa (meadow grass), 73, 84, 274, 275, 427
annua, 275
pratensis, 274, 275
trivialis, 274, 275
Podosphaera leucotricha (Ell. & Everh.)
 Salm., 283, 338
Oxyacanthae (DC.) de Bary, 284, 301
 var. *tridactyla* (Wallr.) Salm., 283
Polyactis Link, 70, 71
cinerea Pers., 70
vera (Fr.) Berk., 71
Polygonum, 84, 147
Bistorta, 76
Polypodium vulgare, 334
 var. *serratum*, 334
Polyporus (Mich.) Fr., 57, 71, 85, 172
anceps Peck, 203
balsameus Peck, 203
benzoinus (Wahlenb.) Fr., 204
Berkeleyi Fr., 203
betulinus (Bull.) Fr., 103, 300
borealis (Wahlenb.) Fr., 203
circinatus Fr., 179, 180, 181, 182, 183, 184,
 185, 186, 187, 188
 var. *dualis* Peck, 181, 185, 188
 var. *proliferus* Peck, 181
dryadeus (Pers.) Fr., 304
dualis Peck, 179, 180, 181, 183, 184, 185,
 186, 188
guttulatus Peck, 203
hispidus (Bull.) Fr., 301
leporinus Fr., 183
mollis (Pers.) Fr., 203
radiatus (Sow.) Fr., 297, 300
rugulosus Lasch, 203
Schweinitzii Fr., 204, 302, 303
squamosus (Huds.) Fr., 300, 301, 303, 305
sulphureus (Bull.) Fr., 304
tephroleucus Fr., 203
tomentosus Fr., 179, 180, 181, 182, 183, 184,
 185, 186, 187, 188
 f. *circinatus* (Fr.) Sartory & Maire,
 183, 187
 var. *circinatus* (Fr.) Sartory & Maire, 188
triqueter Fr., 183
umbellatus Fr., 102, 201

- Polyspora Lini Laff., 305
 Polystictus Fr., 180, 182, 185
 circinatus, 184
 tomentosus, 183
 versicolor (Linn.) Fr., 201, 203
 Populus (poplar), 102, 303
 alba, 303
 balsamifera, 303
 canadensis, 170
 candicans, 303
 generosa, 303
 laurifolia, 303
 nigra, 303
 robusta, 303
 tremula, 303
 trichocarpa, 303
 Poria incrassata (Berk. & Curt.) Burt, 203
 subacida Peck, 293
 Vaillantii (DC.) Fr., 201
 vaporaria (Pers.) Fr., 201, 203
 Weirii Murrill, 203
 xantha (Fr.) Lind., 201, 203
 Potash deficiency, 279, 283
 Potato Blight, 218
 Potato Virus, 218
 Potentilla, 94, 295
 Comarum, 89
 President: Miss E. M. Blackwell, 226
 W. C. Moore, 1, 226
 H. Wormald, 1
 Presidential Address: Recent research on
 diseases of fruit trees and bushes in Britain,
 by H. Wormald, 4
 Organization for Plant Pathology in Eng-
 land and Wales—Retrospect and pro-
 spect, by W. C. Moore, 229
 Primula, 76, 77, 95, 104, 208, 295, 296
 acaulis, 209
 elatior, 209
 ianthina, 295
 japonica, 295
 Juliae, 209, 427
 leucochoa, 295
 malacoides, 296
 muliensis, 295
 obconica, 296
 officinalis, 208
 rosea, 208
 russeola, 295
 sinoplagaginea, 295
 sinopurpurea, 295
 sonchifolia, 295
 szechuanica, 295
 vulgaris, 295
 Proceedings, 215, 337, 440
 Proofs, reading of, 211
 Protomyces Rhizobius Trail, 275
 Prunus (cherry, peach, plum), 6, 7, 8, 12, 14,
 15, 17, 20, 70, 73, 84, 246, 247, 248, 249,
 283, 284, 338, 431
 Amygdalus, 246, 296
 avium, 284
 Besseyi, 296
 Cerasus, 86
 domesticus, 6, 7, 8, 14, 20, 73, 84, 283, 284,
 338
 incisa, 296
 Laurocerasus, 296
 Padus, 168, 283, 284
 Pissardii, 246
 spinosa, 131, 283, 284
 Psalliota (mushroom), 53, 54, 57, 61, 65, 66,
 90, 102, 200, 208, 282, 428
 Psamma arenaria, 277
 Pseudodiscus Hösterm. & Laub., 89
 Pseudomonas Migula, 216, 283
 Begoniae (Buchw.) Stapp, 288
 campestris (Pamm.) E. F. Smith, 268, 280
 marginalis Stapp, 216
 Medicaginis Sackett, var. phaseolicola
 (Burkh.) G. K. K. Link & Hull, 216,
 273
 mors-prunorum Wormald, 246, 247, 248,
 249, 283, 284
 prunicola Wormald, 246, 248
 Pseudomonilia Geiger, 72
 Pseudonectria Seaver, 435
 Rousseliana (Mont.) Seaver, 177, 435
 Pseudoperonospora Humuli (Miyabe & Tak.)
 G. W. Wilson, 305
 Pseudopeziza Ribis Kleb., 285
 Trifolii (Biv.-Bern.) Fuckel, 274
 Pseudotsuga Douglasi, 303
 Psilocybe semilanceata Fr., 276
 Psilonia Fr., 62
 Psilospora Rabenh., 136
 faginea Rabenh., 136
 Quercus Paoli, 135, 136
 Psilosporina Died., 135
 Pteridium, 53, 102
 Pteris, 291
 Wimsetti, 291
 Puccinia agropyrina Erikss., 277
 Agrostidis Plowr., 276, 287
 Anthoxanthi Fuckel, 276
 Antirrhini Diet. & Holw., 287
 Apii Desm., 282
 Arrhenatheri Erikss., 276
 Asparagi DC., 268
 Brunellarum-Moliniae Cruchet, 277
 Buxi DC., 288
 Campanulae Carm., 289
 Chrysanthemi Roze, 289
 coronata Corda, 271, 274, 275, 276, 277
 Cyani Pass., 289
 depauperans Syd., 298
 Festucae Plowr., 275
 glumarum (Schum.) Erikss., 217, 270, 271,
 277
 graminis Pers., 270, 271, 274, 275, 276, 277,
 288, 434
 holcina Erikss., 277
 Iridis (DC.) Wallr., 292
 Malvacearum Mont., 287
 Menthae Pers., 282
 mirabilissima Peck, 269, 283
 Pazschkei Dietel, 297
 perplexans Plowr., 275
 Phlei-pratensis Erikss. & Henn., 275
 poarum Niels., 275
 Porri (Sow.) Wint., 281
 Primulae Duby, 295
 Pringsheimiana Kleb., 21, 285
 Prostii Moug., 298

- Puccinia* (continued)
Pruni-spinosae Pers., 284, 287
Ribis DC., 285
secalina Grove, 271
simplex Erikss. & Henn., 271
suaveolens (Pers.) Rostr., var. *Centaureae* Magn., 289
tritricina Erikss., 268, 270
Vincae (DC.) Beck, 83
Violae (Schum.) DC., 298
Pucciniopsis *Caricae* Earle, 433
Caricae (Speg.) Seaver, 433
Pulicaria, 94
Pullularia Berkh., 329
pullulans (de Bary & Loew) Berkh., 274, 291, 329
Pyraecanthia *coccinea* var. *Laelandei*, 296
Pyrenophora *Rabenh.*, 91, 92
Avenae Ito & Kurib., 271
teres Drechsl., 435
Pyrethrum *roseum*, 296
Pyrus, 63, 72, 75, 97
Aucuparia (rowan), 304
communis (pear), 8, 12, 13, 15, 16, 17, 61, 63, 86, 283
Malus (apple), 6, 7, 8, 9, 10, 11, 12, 13, 20, 21, 54, 60, 63, 64, 65, 66, 75, 77, 78, 79, 86, 97, 98, 99, 100, 103, 148, 168, 218, 283, 338, 427, 431, 432
Pythiacystis Smith & Smith, 152
Pythiogeton v. *Minden*, 152, 156, 323
uniforme Lund., 323, 324
Pythiomorpha *Petersen*, 148, 149, 150, 152, 154, 155, 156, 157, 158, 159, 160, 161, 219, 316, 322, 323, 324
Fischeriana Höhnk., 155, 156, 157, 163
'gonapodioides', 151
'gonapodioides', 155
gonapodyides *Petersen*, 148, 149, 150, 151, 152, 154, 155, 157, 159, 160, 161, 163, 219, 322
'gonapodyoides', 154
'gonapodioides', 155
Miyabeana Ito & Nagai, 155, 157, 163
Oryzae Ito & Nagai, 155, 156, 157, 163
undulata (*Petersen*) *Apimis*, 154, 155, 157, 158, 163
Pythium *Pringsh.*, 148, 149, 150, 151, 152, 154, 156, 159, 160, 161, 219, 278, 282, 287, 288, 289, 290, 291, 293, 295, 297, 316, 323, 324, 325, 340, 410
complexens *Braun*, 288
de Baryanum *Hesse*, 282
diacarpum *Butler*, 156
helicoides *Drechsl.*, 156
intermedium *de Bary*, 294
megalacanthum *de Bary*, 289
oedochilum *Drechsl.*, 156
palignes *Drechsl.*, 156
polytylum *Drechsl.*, 156
proliferum *de Bary*, 151, 156, 160
ultimum *Trow*, 272
undulatum *Petersen*, 151, 154, 156
Pyxidiphora *Nyctalidis* *Bref. & v. Tavel*, 79
Quercus (oak), 59, 71, 77, 80, 83, 92, 101, 102, 103, 131, 133, 134, 441
Ilex, 92
Robur, 304
Ramsbottom, J., 'Annual Meeting, 14 December 1940', 1
'Annual General Meeting, 13 December 1941', 226
'Conclusions and prospects', 436, 441
'Dillenius as a mycologist—and some odd notes', 220
'Fungus Foray, Epping Forest, 4 October 1941', 223
'*Gloeosporium Nicolai* Aggéry and *Gloeosporium Polypodii* Aggéry', 334
'*Macowania*, *Hypocharnum* or *Macowanites*?', 335
'*Volvaria surrecta* (Knapp) comb.nov.', 326
Ramularia *Sacc.*, 76, 77, 85, 208
agrestis *Sacc.*, 299
Armoraciae *Fuckel*, 282
Campanulae-latifoliae *Allesch.*, 289
Cicutae *Karst.*, 427
deflectens *Bres.*, 299, 427
Epilobii-palustris *Allesch.*, 94, 427
filaris *Fres.*, var. *Lappae* *Bres.*, 94
Geranii (*Westend.*) *Fuckel*, 95
lactea *Desm.*, 299
macrospora *Fres.*, 289
var. *Asteris* *Sacc.*, 94
var. *Senecionis* *Sacc.*, 95
Malvae *Fuckel*, var. *Malvae-moschatae* *Sacc.*, 95
nivea *Kab. & Bub.*, 94
Primulae *Thuem.*, 208, 209, 427
Rhei *Allesch.*, 282
Tulasnei *Sacc.*, 286
vallisumbrosae *Cav.*, 208, 294
Veronicae *B. & Br.*, 77
Veronicae *Fuckel*, 77
Violae *Trail*, 299
Ranunculus, 85, 94, 96, 147
acris, 76
repens, 76, 427
Raphanus *Raphanistrum*, 280
Raspberry *Mosaic*, 18
Red Core of strawberry, 17
Red pine, 188
Rehmelliopsis *bohemica* *Bub. & Kab.*, 299
Report of sub-committee on plant disease measurement in the field, by *F. C. Bawden*, 218
Reseda *odorata*, 89, 296
Reversion in black currant, 18, 19
Rhabdoclone *Pseudotsugae* *Syd.*, 303
Rhamnus, 88, 271
catharticus, 170
Rheum (*rhubarb*), 17, 96, 282
Rhipidium *americanum* *Thaxt.*, 321, 324
continuum *Cornu*, 321, 324
europaeum v. *Minden*, 321, 324
var. *compactum* *Forbes*, 321
Rhizoctonia *DC. ex Fr.*, 102, 103, 285, 298
Rhizomorpha *subterranea* *Pers.*, 438
Rhizophidium *clinopus* *Scherff.*, 47
echinatum (*Dang.*) *Fischer*, 47
**Lecythii* *C. T. Ingold*, n.sp., 45, 46, 47
sphaerocarpum (*Zopf*) *Fischer*, 43

- Rhizopus* Ehrenb., 289
 nigricans de Bary, 435, 441
 stolonifer (Ehrenb. ex Fr.) Lind, 435
Rhizosphaera Kalkhoffi Bubák, 299, 302, 303
Rhodocybe Maire, 436
Rhododendron, 58, 296
 ferrugineum, 296
 hirsutum, 296
 maximum, 148
Rhodopaxillus Maire, 436
Rhopalocystis phaeocephala (Sacc.) Grove, 68
Rhopalomyces Corda, 76, 80
Rhus (sumach), 296
Rhynchoectria v. Hoehn., 173, 174
 longispora (Phill. & Plowr.) v. Hoehn., 173
Rhynchosporium Secalis (Oud.) Davis, 217, 268, 271
Rhytisma *acerinum* (Pers.) Fr., 299
 punctatum (Pers.) Fr., 299
 salicinum Pers., 304
Ribes (currant), 6, 21, 53, 97
 Grossularia (gooseberry), 6, 16, 21, 284, 285
 nigrum (black currant), 17, 18, 19, 285
 rubrum (red currant), 285
Ribes Virus 1 K. M. Smith, 285
Richardia africana, 296
Rivea, 76
Roach, W. A., 'The use of plant injection in plant pathology', 338
Robinia pseudacacia, 175, 304
Romneya Coulterii, 296
Rosa, 63, 131, 132, 140, 296, 297
 canina, 131, 297
 tomentosa, 297
Rosellinia de Not., 72
 aquila (Fr.) de Not., 83, 302
 Desmazierii (B. & Br.) Sacc., 73
 necatrix (Hartig) Berlese, 268
Rozites Karst., 336
Rubus, 13, 17, 19, 55, 82, 101, 102, 103, 130, 131, 132
 (blackberry), 13
 (loganberry), 13, 17
 Idaeus (raspberry), 13, 16, 17, 18, 19, 285, 286, 440
Rumex, 77, 95, 130, 131, 147
Russula Fr., 60, 439
 adusta (Pers.) Fr., 166
 aurantiolutea Kauff., 224
 citrina Gill., 224
 constans Karst., 224
 disparilis Burl., 224
 farinipes Rom., 224
 foetens (Pers.) Fr., 223
 ochroleuca (Pers.) Fr., 223
 pectinata Ricken, 223
 Queletii Fr., f. *albocitirina* Barb., 224
 Raoultii Qué., 224
 sardonias Bres., 439
 sardonias Fr., 439
 solaris Ferd. & Winge, 223
Sabouraudites Ota & Lang., 336
Saccharum (sugar cane), 144
Salix (willow), 79, 86, 96, 99, 103, 131, 304, 352, 353, 360, 381, 384, 398, 404, 408, 409, 427
Sambucus (elder), 96, 176, 177, 316
Samuel, G., 'Some reflexions on the control of virus diseases', 338
Saponaria, 99
Saprolegnia Nees, 151, 322
Sapucaya, 103
Saxifraga, 96, 297
 aizoon var. *cultrata*, 297
 cotyledon var. *Caterhamensis*, 297
 Hostii, 297
 var. *rhaetica*, 297
 longifolia, 297
 umbrosa, 96
Scabiosa, 147
 Succisa, 96
Schiffnerula pulchra (Sacc.) Petr., 99
Schinzia Alni Woron., 300
Schizanthus, 297, 313
Schizonella, 144
Schizosaccharis Lindner, 437
Schizosaccharomyces Kloeck., 437
Schroeteria Winter, 144
Schwanniomyces Kloeck., 437
Scilla, 28, 147, 196, 197, 297
 campanulata, 194, 196, 197
 var. *albida*, 194
 nutans (bluebell), 102, 194, 197, 198, 199, 297
 verna, 297
Scirpus, 54, 84, 147
Sclerococcum Fr., 98
Scleroderma Pers., 62
Scleroderis fuliginosa (Pers.) Karst., 304
Sclerotinia Fuckel, 26, 27, 28, 30, 75, 329, 330
 Candolleana (Lév.) Fuckel, 102, 304, 330
 Crataegi Magn., 301
 Curreyana (Berk.) Karst., 58, 103
 Ficariae Rehm, 330
 fructigena Aderh. & Ruhl., 12, 75, 283, 284
 Gladioli Drayton, 26, 102, 291, 294, 435
 homococarpa Bennett, 298
 laxa Aderh. & Ruhl., 12, 283, 284, 296
 f. *Mali* (Worm.) Harrison, 283
 **narcissicola* P. H. Gregory, n.sp., 28, 29, 35, 36
 polyblastis P. H. Gregory, 27, 28, 29, 32, 34, 37, 70, 294
 Porri v. *Beyma*, 27
 (*Stromatinia*) *pseudotuberosa* Rehm, 330
 Ricini Godfrey, 27
 sclerotiorum (Lib.) de Bary, 103, 268, 272, 278, 279, 282, 287, 288, 289, 292, 294, 330
 **sphaerosperma* P. H. Gregory, n.sp., 37, 38
 temulenta (Prill. & Delacr.) Sacc. & D. Sacc., 329
 Trifoliorum Erikss., 274
 Trifoliorum Erikss., var. *minor* Alcock & Martin, 274
 tuberosa (Hedw.) Fuckel, 287
Sclerotium Tode, 294
 cepivorum Berk., 281
 durum Pers. ex Fr., 70
 Gladioli Massey, 26
 rhizoides Auersw., 277
 roseum Moug. ex Fr., 438
 tuliparum Kleb., 277

- Scolecotrichum* Kunze & Schm., 87
 graminis Fuckel, 275, 277
 uniseptatum (Berk. & Curt.) Cooke, 85, 87
Scolopendrium, 99
 officinale, 334
Scopulariopsis Bainier, 63, 78
 Scotland, list of plant diseases of, 266
Scrophularia, 96
 nodosa, 76
Secale (rye), 87, 147, 271, 332
Selenosporium tubercularioides Corda, 64
Senecio, 95, 96
 elegans, 281
 Jacobaea, 281
 Smithii, 297
 sylvaticus, 281
 vulgaris, 281
Sepedonium Link ex Fr., 80, 86
 chrysospermum Fr., 80, 81
 mucorinum Harz, var. *botryoides* Bayl. Ell., 80
Septobasidium Pat., 72
Septocylindrium aromaticum Sacc., 427
 Ranunculi Peck, 427
Septogloeum Sacc., 103
 Fragariae, 268
 salicinum Sacc., 304
 Ulmi (Fr.) Died., 305
Septonema Corda, 96, 97, 129, 138, 139
 toruloideum Cooke & Ellis, 138
Septoria Fr., 210, 432
 affinis Sacc., 277
 Apii Chester, 282
 Avellanae B. & Br., 300
 Avenae Frank, 271
 castaneicola Desm., 300
 cercosporioides Trail, 290
 chrysanthemella Sacc., 289
 divaricata Ell. & Everh., 295
 Gladioli Passer., 291
 graminum Desm., var. *Moliniae* Trail, 277
 Helenium Ell. & Everh., 209, 210
 nodosum Berk., 270
 nubilosa Ell. & Everh., 210
 obscura Trail, 289
 oxyspora Penz. & Sacc., 275, 276
 Paconiae Westend. var. *berolinensis* Allesch., 294
 Petroselinii Desm., 282
 piricola Desm., 283
 pterophila Sacc., 258
 Rosae Desm., 297
 Rubi Westend., 286
 rufomaculans Berk., 431
 Scillae Westend., 297
 sinarum Speg., 290.
 Sorbi Lasch, 304
 Tritici Desm., 268
 Violae Westend., 299
Sequoia gigantea, 304
 Severe Crinkle of raspberry, 16
Silene, 93, 147
 Cucubalus, 291
 maritima, 291
 nutans, 291
 Silver Leaf, 6, 7, 8, 283, 284
 Silver Scurf of potato, 97
 Singh, B., 'Bulb rot of *Scilla nutans* caused by *Penicillium Cyclopium* Westling', 194
Sirothecium Karst., 82
Sisymbrium Alliararia, 280
 officinale, 280
 Sitones, 306
 Sketches of the growth of the potato from planting to harvest, with special reference to humus deficiency, by E. C. Large, 337
 Sleepy Disease of tomato, 64
 Slime flux, 57, 58
 Smoulder, 35
 Smut fungi, a method of characterizing, by G. C. Ainsworth, 141
 Smut of oats, 216
Smyrnum, 100
 Soft rots due to green fluorescent bacteria, by W. J. Dowson, 215
Solanum, 177
 Dulcamara, 176, 177
 Lycopersicum (tomato), 17, 61, 64, 84, 85, 90, 98, 99, 216, 278, 279, 313
 tuberosum (potato), 17, 21, 55, 58, 61, 64, 65, 67, 97, 98, 99, 100, 104, 171, 216, 268, 271, 272, 273, 313, 337, 421, 440
Solanum Virus 1 K. M. Smith, 271, 272, 278
 2 K. M. Smith, 271
 3 K. M. Smith, 271, 272
 14 K. M. Smith, 271, 272
Solidago, 89
 Some reflexions on the control of virus diseases, by G. Samuel, 338
 Some water moulds of the Hogsmill River collected from 1937 to 1939, by G. M. Waterhouse, 315
Sonchus arvensis, 281
 asper, 281
 oleraceus, 281
Sorosporella Sorok., 262, 263, 264, 265
Agrotidis Sorok., 263, 264
 uvella (Krass.) Giard, 262, 263, 264
Sorosporium Rudolphi, 144
 Tembuti P. Henn. & Evans, 144
Sparassis Fr., 62
 crispa (Wulf) Fr., 303
Sparganium, 73, 84
Spegazzinia ammophila Rostr., 100
Spira Corda, 98, 100
 toruloides Corda, 100
 var. *translucens* Grove, 100
Sphacelia segetum Lév., 57
Sphaceloma Rosarum (Passer.) Jenk., 297
Sphacelotheca de Bary, 144
 cruenta (Kuehn) Potter, 145
 Hydropiperidis (Schum.) de Bary, 147
 Sorgi (Link) Clint., 145
Sphaerella Ces. & de Not., 429
Sphaerella Sommerf., 429
 Tulasnei Jancz., 435
Sphaeria Fr., 175, 435
 cerea Berk. & Curt., 178
 coccinea auct., 168
 flacca Wallr., 176
 solida Sow., 70
 xantholeuca Kunze, 175

- Sphaeronaemella* Karst., 62, 166, 167
blepharistoma Berk., 166
fimicola March., 167
Helvellae Karst., 167
Sphaeronema Fr., 167
oxysporum Berk., 167
subulatum Fr., 167
vitreum Corda, 166
Sphaeropsis malorum Berk., 283, 296
Sphaerostilbe aurantiaca Tul., 59
flammea Tul., 67
flavoviridis Fuckel, 63
Sphaerotheca Humuli (DC.) Burr., 285, 286, 305
mors-uvae (Schw.) Berk., 284, 285
pannosa (Wallr.) Lév., 296
var. Persicae Woronich., 284
tomentosa Otth, 291
Sphaerulina Taxi Mass., 304
Spicaria Harz, 261
elegans (Corda) Harz, var. *muscorum*
Grove ex Sacc., 81
(Isaria) farinosa, 260, 261
gracilis Petch, 261
prasina (Maubl.) Saw., 261
Solani Hartig, 58
Spiloma Ach., 100
Spinacia, 93
Spiraea, 71, 76, 82
Ulmaria, 96
Spondylocadium atrovirens Harz, 272
Spongopora subterranea (Wallr.) Lagerh., 272
Sporidesmium Link ex Fr., 85, 90, 100, 101
atrum Link ex Fr., 90
Peziza Cooke & Ellis, 71
Sporocybe Fr., 55, 59, 79
Azaleae (Peck) Sacc., 296
Sporodesmium polymorphum Corda var. *chartarum* Cooke, 100
Sporotrichum Link ex Fr., 83
chrysospermum Harz, 80, 81
Isariae Petch, 74, 81
resinae Cooke, 86
 Spread of major crop diseases from country to country, by S. P. Wiltshire, 218
Stachybotrys Corda, 58, 79
Stachylidium Link ex Fr., 61, 69, 70
Stagonospora compta (Sacc.) Died., 274
Curtisii (Berk.) Sacc., 294
Stalagmites Theiss. & Syd., 336
Stellaria, 93
graminis, 291
palustris, 291
Stemonitis Gleditsch, 172
fusca Roth, 172
Stemphylium Wallr., 97, 100
 Stephens, F. L. and Ramsbottom, J., 'Atichia', 337
Stereum Pers., 431
purpureum Pers., 283, 284, 338
sanguinolentum (Alb. & Schw.) Fr., 201
Sterigmatocystis Cramer, 68, 69
dubia (B. & Br.) Sacc., 68
Stilbella Syd., 55, 59
Stilbum (Tode) Jucl., 55, 56, 58, 59, 60
vulgare Tode, 59
Stransvaesia Davidiana, 297
Strawberry Aphis, 19
Strawberry Crinkle, 18
Strawberry Yellow-edge, 18
Stromatinia Boud., 274, 329, 330
 Studies on British Chytrids. I. *Phlyctochytrium proliferum* sp. nov. and *Rhizophidium Lecythii* sp. nov., by C. T. Ingold, 41
 Studies on *Sclerotinia* and *Botrytis*. I, by P. H. Gregory, 26
Stylonectria applanata v. Hoehn., 170
Stypinella Schroet., 433
Stysanus Corda, 72, 82
Sugar beet Yellows, 218
Symphysira Preuss, 82, 427
Symphytum officinale, 76
Synchytrium endobioticum (Schilb.) Perc., 272
Synghiocladium Petch, 262, 263, 264, 265
araneum Petch, 264
Cleoni (Wize) Petch, 263, 265
**intricatum* Petch, n.sp., 264
Synnematum Speare, 265
Syringa (lilac), 93, 297
Syzygites Ehrenb., 336
 Take-All, 217
Tanacetum, 96
Taphrina aurea (Pers.) Fr., 303
bullata (Berk.) Tul., 283, 301
Cerasi (Fuckel) Sadeb., 284
coerulescens (Dur. & Mont.) Tul., 304
deformans (Berk.) Tul., 284, 296
Johansonii Sadeb., 303
minor Sadeb., 284
Pruni (Fuckel) Tul., 284
Sadebeckii Johans., 300
Tosquinetii (Westend.) Magn., 300
turgidus (Fuckel) Sadeb., 300
Taraxacum, 96, 281
Tarichium Cohn, 263
uvella Krass., 263
Taxus baccata (yew), 304
 Taylor, R. E., 'A wilt disease of *Godetia* and other ornamental plants', 215
Testicularia Klotzsch, 145
**Tetrachaetum* Ingold, n.gen., 380, 381, 383, 384, 401, 413
**elegans* Ingold, n.sp., 340, 377, 378, 379, 380, 381, 383, 406, 411, 413, 416, 417
Tetracladium-like fungi from a stream in Leicestershire, by C. T. Ingold, 219
Tetracladium De Wild., 219, 374, 383, 387, 413
Marchalianum De Wild., 219, 340, 341, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 410, 411, 413, 416, 417
**maxilliformis* (Rostr.) Ingold, n.comb., 372
**setigerum* (Grove) Ingold, n.comb., 340, 369, 370, 371, 372, 413, 415, 416
Tetraedron longispinum, 383
Teucrium, 130
Thalictrum, 147
Thecaphora seminis-convolvuli (Desm.) Liro, 147
Trailii Cooke, 147
Thecopsora areolata Magn., 302
Thelephora (Ehrh.) Fr., 83

- Thelis* Clem., 437
Theobroma, 95
Thielavia Zopf, 63
Thielaviopsis basicola (Berk.) Ferraris, 63, 104, 278, 279, 280, 293, 295
 Thompson, M. V., see Blackwell, E. M.
Thosca recta, 260
Thraustochytrium Sparrow, 43
proliferum Sparrow, 43
Thuya, 304
 plicata, 202, 203, 204, 205
Tilachlidium Preuss, 264
Tilia, 89, 91
Tilletia Tul., 144
 caries (DC.) Tul., 144, 147, 217, 270
 decipiens (Pers.) Koern., 147, 276
 Holci (Westend.) Schroet., 147, 277
 laevis Kuehn., 435
 Lolii Auersw., 147
 Menieri Har. & Pat., 147
 Tritici (? Bjerck.) Wint., 435
Titaea Sacc., 371, 372, 413
 callispora Sacc., 371
 Clarkei Ell. & Everh., 371, 372
 maxilliformis Rostr., 371, 372, 413
 ornithomorpha Trotter, 371
 rotula v. *Hoehn.*, 371
Tolyposporium Woronin, 144
Tomentella Pat., 83
Torribiella arancida Boud., 258
 Blattae Petch, 258
Torula Pers., 55, 63, 73, 90, 434
 abbreviata Corda, var. *sphaeriiformis* B. & Br., 82
 alternata Fr., 434
 tenera, 434
Tracya Syd., 145
Tradescantia, 69
Tragopogon (salsify), 147, 282
Trametes circinatus Fr., 180, 181, 186
 perennis, 180, 181
 Pini (Brot.) Fr., 203, 303
 Schweinitzii Thuem., 180, 181
 serialis Fr., 201, 203, 204
 subrosea, 203
 tomentosus Fr., 181
 Treasurer's accounts, 3, 228
Treleasia Speg., 174, 175
 musciola Speg., 174
 Sacchari Speg., 174
Tremella atrovirens (Fr.) Sacc., 103
 mycetophila Peck, 307
Trichia Haller, 81
 verrucosa Berk., 58
Trichoderma Pers., 195
 viride Pers. ex Fr., 68, 294
Tricholoma Fr., 436
 melaleucum (Pers. ex Fr.) Quél., 436
Trichosporium *Tulasnei* Lindau, 74, 83
Trichothecium candidum Wallr., 87
 fuscum Fr., 85
 obovatum (Berk.) Sacc., 87
 **Tricladium* Ingold, n.gen., 388, 389, 413
 **angulatum* Ingold, n.sp., 340, 389, 390, 391, 392, 393, 406, 411, 413, 416
 **splendens* Ingold, n.sp., 340, 385, 386, 387, 388, 389, 391, 392, 393, 411, 413, 416, 417
Tridentaria Grove, 370
 carnivora Drechs., 387, 412
 implicans Drechs., 387, 412
 setigera Grove, 341, 370, 413
Trientalis, 77, 96, 147
Trifolium (clover), 76, 86, 100
Trifolium hybridum (alsike), 274
 medium, 175, 274
 minus, 274
 pratense, 69
 purpureum, 274
 repens, 274
Triglochin, 100
Triticum (wheat), 64, 66, 89, 92, 144, 147, 177, 216, 217, 218, 270, 271
Trochila Buxi Capron, 288
 Laurocerasi (Desm.) Fr., 296
Trollius, 62
Tropaeolum majus, 298
Tsuga Albertiana, 305
 canadensis, 305
Tuber Dill., 220
Tubercularia Wigg., 52, 83
 vulgaris Tode, 251
Tuberculina Sacc., 102
Tubercinia primulicola (Magn.) Bref., 104, 295
 Trientalis B. & Br., 147
Tulipa (tulip), 28, 64, 70, 71, 103, 298
Tulipa Virus 1 K. M. Smith, 294, 298
 Turf, diseases of, 298
Tussilago, 94
 Twyman, E. S., '*Colpoma quercinum*', 337
Typha, 85, 93
Typhula (Pers.) Fr., 102
 phacorrhiza Fr., 103
 Trifolii Rostr., 274
Ulex (gorse), 60, 62, 75
Ulmus (elm), 56, 59, 63, 71, 84, 305
 montanus (wych elm), 305
Uncinula Aceris (DC.) Sacc., 299
 necator (Schw.) Burr., 286
 prunastri (DC.) Sacc., 283
 Salicis (DC.) Wint., 304
Uredo Pers., 434
 Airae Lagerh., 277
 ammophilina Kleb., 277
 anthoxanthina Bub., 276
 Festucæ DC., 275
 Gladioli Requien ex Duby, 434, 438
Urocystis Rabenh., 144
 Agropyri (Preuss) Schroet., 147, 275, 277
 Anemones (Pers.) Wint., 147
 Cepulae Frost, 147, 281
 Colchici (Schlecht.) Rabenh., 147
 Fischeri Koern., 147
 Gladioli W. G. Sm., 433, 434, 438
 Gladioli (Requien) W. G. Sm., 433, 434
 occulta (Wallr.) Rabenh., 147
 sorosporoides Koern., 147
 Violae (Sow.) Fisch. de Waldh., 147, 299
Uromyces Armeriae Lév., 288
 Betae Lév., 282
 caryophyllinus Wint., 290
 Dactylidis Orth, 276
 Fabae (Pers.) de Bary, 280

- flectens Lagerh., 274
 Poae Rabenh., 275
 Scillarum Wint., 294, 297
 Trifolii Lév., 274
 Trifolii-repentis Liro, 274
 Urtica (nettle), 54, 66, 67, 73, 87, 88, 96, 166, 171
 Use of plant injection in plant pathology, by W. A. Roach, 338
 Ustilago (Pers.) Roussel, 434
 Avenae (Pers.) Jens., 145, 147, 271
 bromivora (Tul.) Fisch. de Waldh., 147
 ficuum Reichardt, 68
 Hordei (Pers.) Lagerh., 147, 271
 hypodytes (Schlecht.) Fr., 144, 147, 277
 Kollerii Wille, 147, 271
 Kuehneana Wolff, 147
 levis (Kellerm. & Swing.) Magn., 435
 longissima (Sow. ex Schlecht.) Meyen, 147, 275
 major Schroet., 147
 marina Durier, 147
 nuda (Jens.) Rostr., 147, 271
 Ornithogali (Schum. & Kunze) Magn., 147
 perennans Rostr., 147, 276
 Scabiosae (Sow.) Wint., 147
 scitaminea Syd., 144
 striaeformis (Westend.) Niessl, 147, 275, 276, 277
 Tragopogi-pratensis (Pers.) Wint., 147
 Tritici (Pers.) Rostr., 145, 147, 217, 270
 utriculosa (Nees) Tul., 147
 Vaillantii Tul., 147, 289, 297
 vinoso (Berk.) Tul., 147
 violacea (Pers.) Rouss., 147, 291
 Zeae (Beck) Unger, 147
 Valeriana, 96
 Varicosporium Kegel, 413
 Elodeae Kegel, 340, 341, 394, 395, 396, 398, 410, 411, 413, 416, 417
 Venturia inaequalis (Cooke) Wint., 9, 86, 283
 pirina Aderh., 283
 Vermicularia cicadina Ell. & Kell., 258
 Veronica, 77, 89, 298
 propinqua, 298
 Verticillium Nees, 64, 83, 103, 261, 287, 289, 290
 agaricinum Corda, 61, 103
 albo-atrum Reinke & Berth., 17, 272, 278, 279, 440
 cinerescens Wollenw., 291
 coccorum (Petch) Westerd., 261
 Dahliae Kleb., 17, 186, 440
 Eriophyitis (Masse) Sacc. & Trott., 53
 lateritium Berk., 53
 Malthousei Ware, 282
 tubercularioides Spég., 169
 Vilmorinii Westerd. & v. Luijk, 288
 Verticillium wilt of hops, by W. G. Keyworth, 440
 Vespa (wasp), 306
 Viburnum, 89
 Vicia Cracca, 279, 280
 Faba (broad bean), 89, 280, 425
 sativa, 279, 280
 sepium, 279, 280
 Viola, 57, 89, 94, 98, 147, 298, 299, 427
 arvensis, 298
 canina, 298
 Curtisii var. Fosteri, 298
 hirta, 298
 lutea var. amoena, 298
 odorata, 298, 299
 palustris, 299
 Riviniana, 298, 299
 sylvatica, 298, 299
 tricolor, 298, 299
 Violet Root rot, 268
 Virgaria olivacea (Link) Gray, 81
 uniseptata Berk. & Curt., 85
 Virus diseases, 18
 Vitis, 89, 98
 vinifera (vine), 61, 286, 287, 431
 Volutella stipitata (Lib.) B. & Br., ex Cooke, 62
 Volvaria Fr., 326
 hypophyths (Fr.) Karst., 328
 subsp. Loveiana (Berk.) Konr. & Maubl., 328, 436
 Loveiana (Berk.) Quél., 326
 *surrecta (Knapp) Ramsb., n.comb., 326, 436
 Volvariaurrecta (Knapp) n.comb., by J. Ramsbottom, 326
 Vouauxiella Petrak & Syd., 82
 Wakefield, E. M., 'Why rules?', 428, 441
 Wakefield, E. M. and Bisby, G. R., 'List of Hypophymycetes recorded from Britain', 49, 427
 Warpuria, 92
 Waterhouse, G. M., 'Some water moulds of the Hogsmill River collected from 1937 to 1939', 315
 see Blackwell, E. M.
 Weston, W. A. R. Dillon, 'Field observations on some cereal diseases and their control', 216
 White Root rot, 268
 Whiteheads, 218
 Wiesneriomyces Koord., 429
 Wilt disease of *Godetia* and other ornamental plants, by R. E. Taylor, 215
 Wiltshire, S. P., 'The spread of major crop diseases from country to country', 218
 Wolf, F. T., 'An addition to the fungus flora of Barro Colorado Island', 191
 Wormald, H., 'Bacterial diseases of stone-fruit trees in Britain. VIII. Bacterial canker of peach', 246
 'Presidential Address. Recent research on diseases of fruit trees and bushes in Britain', 4
 Xanthochrous circinatus (Fr.) Pat., 179, 183
 Xylaria (Hill) Schrank, 103
 Hypoxylon (Linn.) Grev., 428
 Yellow Rust, 218
 Yucca, 89
 Zasmidium Fr., 102
 Zea Mais (maize), 77, 147
 Zinnia, 299
 Zonosporis Clem., 437
 Zygosaccharis Clem., 437
 Zygosaccharomyces Barker, 437

PRINTED IN GREAT BRITAIN BY
W. LEWIS, M.A., AT THE
UNIVERSITY PRESS, CAMBRIDGE